A. Walker del. et sculp.

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THE YOUNG MAN's Book of Knowledge:

BEING A PROPER SUPPLEMENT TO THE YOUNG MAN's COMPANION.

IN SIX PARTS, *viz.*

PART I. Of Knowledge in general; the Advantages of gaining it early, with a Definition thereof. Of God, his Essence and Attributes. Of the Origin of Nature, and first Formation of Things. Of the Creation, Fall, and Restoration of Mankind.

PART II. Theology, containing an Account of the Religion and Laws of Nature. Supernatural Theology. Observations on the Holy Scriptures, which teach us the Knowledge of God and our Duty. Account of Judaism, Paganism, Mahometanism, and Christianity. Of the Sects of the Jews. Different Tenets of the principal Sects or Professors of Christianity. Of the Heathen Mythology, and Alphabetical Account of the Heathen Deities.

PART III. Natural Philosophy in general.

PART IV. Geography, in a Manner entirely new: Containing, (by Question and Answer) 1. A general Description of the four Quarters of the World. 2. The Situation, Extent, and chief Cities of the several Kingdoms and Countries of each Quarter. 3. The Nature and Description of the Globes, and Explanation of the Terms used in Geography. 4. Tables of the Latitude and Longitude of several principal Places, with many useful and necessary Problems on the Terrestrial and Celestial Globes.

PART V. Geometry and Astronomy, Navigation, and Plain-Sailing; with many useful, easy, and instructive Problems for the young Practitioner in the further Knowledge of those Sciences.

PART VI. Of Music and Vibration. Definition of Music. Gamut or Scale, and Explanation of dividing Notes in Time, &c. Of the Diatonic Scale, an Explanation. Different Keys, Time, Bass, &c. &c.

The THIRD EDITION, with Additions.

By D. FENNING,

Author of the ROYAL ENGLISH DICTIONARY, UNIVERSAL SPELLING-BOOK, USE of the GLOBES, &c. &c. &c.

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RECOMMENDERS.

We whoſe Names are hereunto ſubſcribed, beg Leave to recommend the following Work to the Public in general: For though the ſubjects are many, and every one of them uſeful, yet they are ſo well digeſted, and treated of in ſo plain a manner, that it cannot fail of being very uſeful in Schools, and of great Service to Mankind in general.

The Rev. Mr. BERNARD.
The Rev. Dr. CRISPE.
The Rev. Mr. FISKE.
The Rev. Mr. FONTAINE.
The Rev. Mr. KEMP.
The Rev. Mr. MOSS.
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JOHN RULE, A. M. Maſter of a Boarding School at *Iſlington*.

TO THE RIGHT HONOURABLE

WILLIAM BECKFORD,

Lord Mayor of the City of LONDON,
And one of their Repreſentatives in Parliament.

MY LORD,

AS it is too common to find Dedications carried to too high an Extreme of flattering Encomiums, I perſuade myſelf Your Lordſhip will the more readily accept of this, in the plain Dreſs of Simplicity, as I am ſenſible it is not agreeable to your Lordſhip to be flattered.

I acknowledge, my Lord, the Preſumption is too great; but being ſenſible of your Lordſhip's Readineſs to promote every Thing that is of public Service and Utility, I was induced to lay this Work at your Lordſhip's Feet: And the World cannot but commend me for ſending it abroad under the Favour and Protection of one who is not only a Lover of Learning, a Promoter of all Commerce and Induſtry, but one whoſe candid Diſpoſition, true Patriot Spirit, and undaunted Bravery, has been ſo eminently diſtinguiſhed in oppoſing

poſing every Meaſure that has appeared inconſiſtent with the Liberty of the Preſs, and a Free People.

My Lord, as I am proud of profeſſing myſelf a firm Proteſtant, I cannot but rejoice that my Patron is ſo truly attached to his preſent Majeſty, our moſt gracious Sovereign, and a Lover and Encourager of all His true and faithful Subjects: And Your Lordſhip will always ſtand in the Liſt of thoſe worthy Patriots who honour their King, and promote Harmony among the People.

Though the following Lucubrations have coſt me much Time and Labour, yet I think myſelf duly compenſated in having the Honour of ſending them into the World under Your Lordſhip's Sanction and Approbation.

I am, my Lord,

With due Regard and Submiſſion,

Your Lordſhip's moſt obliged,

and moſt obedient humble Servant,

JULY 16, 1763.

D. FENNING.

TO THE

READER,

But more particularly the

Grown-up YOUTH of GREAT-BRITAIN and IRELAND.

YOUNG GENTLEMEN,

I Here preſent you with a Work that has been wanted for many Years, and that cannot fail to be of Service to Mankind in general; and I have waited a long Time, expecting it might have been done by a much abler Hand; but whether it has been for want of Thought of doing public Service, or whether for want of Condeſcenſion in Perſons of greater Abilities, I cannot pretend to determine; evident it is, that it has not been done in a Book of this Price.

2. Every Thing has its Defects; and therefore a Work upon ſo many Subjects, in ſo ſhort a Compaſs, cannot be without; but, if it be ever ſo ſhort, yet if it be but ſo plain and intelligible, to convey a general Idea of Things, or to give the Reader a particular Account of the different Branches of the more ſuperior Parts of Learning, that is ſufficient: If it does *this*, it anſwers the Deſign it was intended for; and a candid, impartial Reader will pardon the more trivial Errors and Deficiencies.

3. Every Perſon who has peruſed the Sheets allows, that what is here treated of is both ſhort and conſpicuous, and that it certainly will be of great Service to Mankind in general, but particularly to the following Perſons: Firſt, to all ſuch Perſons who love to improve themſelves at all Opportunities, but have either left School too ſoon, or have not had the Advantage of reading different Authors, or converſing with ſuch as

could improve them. 2dly, It will be of Service to all ſuch who have had a more ſuperior Education than at every common School, (ſuch as Academies, &c.) who are conſcious they have in Time paſt neglected their Learning, to the Prejudice of their Tutors, and their own palpable Mortification. And, 3dly, It cannot fail of being a great Help to all adult Perſons, and grown-up Youth in Town and Country, who are ſincere Lovers of Improvement, but have neither had Time to read, nor Ability to purchaſe different Authors upon ſo many Subjects, and yet they have a hearty Deſire of being improved, and take equal Delight to improve others alſo:—Theſe are the Perſons for whom the following Sheets were more particularly deſigned: For ſuch may, with Propriety, be called the true Lovers of Learning, and they are juſtly entitled to the Labour of every Author, becauſe they do him Honour in endeavouring to underſtand whatever he treats of, and encouraging others to do the ſame.

4. But there is another Sort of Youth who more particularly deſerve Pity, and yet it is impoſſible to ſpeak any Thing concerning them without, in ſome meaſure, expoſing their Folly. Theſe I would addreſs with all the Marks of Love and Tenderneſs, that they may the more readily attend to what I ſay, and take up a Reſolution to regulate their Conduct for the Time to come. —I mean thoſe pretended polite and faſhionable young Bloods and Blades, who call themſelves Gentlemen, on Account of a ſuperior Fortune, and are very fond you ſhould know they have had a better Education than others. —But are ſo far from being fond of making a good Uſe of it, that they take a Delight to ridicule it, and diſcourage the very Thing that they vaunt themſelves upon.—However inconſiſtent this may appear, yet it is a Fact beyond Contradiction.—Are there not Hundreds (nay, Thouſands) who have had no leſs than an academical, and many who have had even a collegiate Education, with ſuch Advantages of Time and Fortune, that they might very eaſily have been Maſters of ſeveral Languages, and have known the Theory of the Sciences in general; but, inſtead of *this*, they give ſuch a Looſe to their Paſſions, and follow the firſt Thought that prompts them

them to every Pleaſure, without conſidering in the leaſt, how, where, or in what Manner it will end.—Say not this is Detraction.—For do we not ſee many Youths, (eſpecially in our Metropolis) who ſpend the main Part of that beautiful Stage of Life, from 16 to 26 at leaſt, in very little elſe but ſuch low, idle Traſh, and wretched, inconnected, inconſiſtent Stuff and Nonſenſe, that were it not for ſome Difference in their Dreſs, and ſometimes a little more polite outward Behaviour, rather than their Converſation, they could not be diſtinguiſhed from the more baſe, vulgar, illiterate and unlearned.

Thus, inſtead of becoming *ſhining* Examples to others in Learning and good Senſe, they abuſe every Talent that kind Providence has beſtowed upon them; never think of the many indulgent Favours of their Parents and Friends, nor value how they grieve *them*; diſgrace their Tutors, and ſcandalize Learning in general.

In ſhort, there are ſome, who by a long Continuance in Vice, and a total Neglect of all good Learning and Morality, are become ſo abandoned and incorrigible, that it is the higheſt Inſult if you offer to reprove them ever ſo gently, or adviſe them in ever ſo preſſing and tender a Manner: For if they can but boaſt and brag that they were born to a larger Fortune, or have had a better Education than others, they think theſe rotten Pillars are ſufficient to ſupport the whole Syſtem of their Pride, Balderdaſh, and Ribaldry.

5. From hence appears the wide Difference between Induſtry and Idleneſs: For it is evident, there are a great many who have had very little or no Education, and yet by conſtant Reading, and diligent Obſervation, have, in a ſhort Time, become far better Scholars than many others, who had all the poſſible Advantages of Learning, but have paid very little Regard to it while at School, and much leſs when they are out of it.

6. If this be the true State of the Caſe, (as it is plain it is) who then would be ſuch an Enemy to himſelf, to idle away his Time and not try to learn ſomething? And who but giddy, hair-brained Youth, or Madmen and Fools, would wilfully neglect and forget what they were taught? Remember, young Gentlemen, that it is an unvariable and univerſal Maxim, that Self-love is

inſe-

inſeparably linked to our very Nature, and therefore it is abſurd for any of you to ſay, you really love yourſelves, while you neglect all Opportunities of improving both your Minds and your Morals.

7. Having made theſe Obſervations of the different Sorts of Youth, and deſiring they would ſeriouſly conſider the Advantages of gaining an early Knowledge, I ſhall now give ſome account of the Work itſelf.

8. The Title-page ſufficiently ſets forth the whole of this ſmall Treatiſe at one View, but I know it is expected there ſhould be ſome further Deſcription of the Particulars, and ſome Apology made for the Reaſon of the Undertaking.

9. The chief Intention (as ſaid before) is for the further Improvement of all induſtrious Youth, and the Reaſon of making it public is, becauſe they might learn ſomething of the moſt material Subjects at a ſmall Expence.

10. I do not pretend to ſay the Whole is an Original, the hiſtorical Parts, in Courſe, I muſt have borrowed or quoted from other Authors; and they have no greater Claim for what was done before their Time than I have, for they were obliged alſo to write from the ſuppoſed Teſtimonials of others: If then what I have ſelected of this Sort be ſhort and plain, and the principal Parts be well digeſted, that is ſufficient; the ſhorter it is, the more engaging, the leſs burthenſome, and the ſooner underſtood and retained.

11. As to the *Geometrical*, *Trigonomical*, *Aſtronomical*, and *Philoſophical* Part, *&c.* I have taken all the Care, (within the Compaſs of ſuch a Limitation) to be as plain and intelligible as I could; and that the young *Tyro* might not be at a Loſs in the firſt Rudiments of Geometry, *&c.* I have given him the Draught or Figure of every Operation in the Margin or Page of the Work, in order that he may more readily comprehend the Problems; and as for the ſhort Treatiſe on *Muſic*, I have been careful to omit nothing that might help both its Theory and Practice; and I perſuade myſelf it will be of Service both to inſtrumental as well as vocal Performers: For as there are a great many who underſtand the Theory very well, and yet cannot play at all,

all, ſo there are Numbers who can play very well, and yet have very little Judgment in the Rules of Harmony and Compoſition; and had not the Sheets been extended beyond their firſt Limitation, I ſhould have been much fuller upon this Subject; but I hope there are ſufficient Hints for every diligent Reader.

12. As for critical *Carpers*, and half-learned Coxcombs, I am content to ſhare the Fate of my Betters, in whatever Conſtructions they pleaſe to make, deſiring only this, that they would take Care for their own Credit, not to animadvert upon Things they don't underſtand, on purpoſe to detract and leſſen the induſtrious, well deſigned, and uſeful Performances of others.

In fine; let me perſuade all Lovers of Learning to be conſtant and diligent in ſearching after Truth. Let neither the Gay nor the Giddy diſſuade you from purſuing, nor prevail upon you, by any Means whatever, to neglect your Duty to God and yourſelf: Therefore,

Keep always ſuch Company as *You* may improve, or that may improve *You*: And if your Companions cannot make *You*, nor *You Them* better; remember to leave them, rather than be made worſe by them.

I am, kind Reader,

Your Well-Wiſher,

D. F.

CON-

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THE

THE

YOUNG MAN's Book of Knowledge, &c.

PART I.

Of KNOWLEDGE *in general: The Advantage of gaining early Knowledge; with a Definition of true Knowledge to that which is commonly called ſo,* &c.

DIALOGUE I. SECT. I.

Between *Tyro*, a Learner, and *Philo*, his Inſtructor.

Tyro. WHAT do you mean by Knowledge?

Philo. Knowledge, in general, ſignifies Skill, Judgment, or Underſtanding: Or, Knowledge more ſtrictly ſignifies Learning and Erudition, which is the Faculty of forming true and juſt Ideas of Things, and of perceiving and judging right of the Nature of the Object ſought after.

Tyr. What do you mean by an Idea?

Phil. An *Idea* is the firſt Conception, Form, Model, or Pattern of a Thing exiſting in our Imagination, Mind, or Fancy; and therefore, *Tyro*, you ſhould be very careful to form true and juſt Ideas of Things, and then you will always be able to diſcover Truth from Falſhood.

Tyr. I grant, Sir, that it is the higheſt Wiſdom in Youth, to furniſh their Minds betimes with the true Knowledge of Things.

Phil. I am glad you are ſenſible of this; for it is really a melancholy Truth, that the Generality of Mankind do not ſeek after Knowledge at all; or elſe they miſtake the Word Knowledge, and call that Learning or Knowledge, that really is not ſo; and

others there are who abuſe their Education, fruſtrate the good Deſigns of their Friends, and are content to let the common Follies and Gäieties of Life poſſeſs their whole Souls and Inclinations to ſuch a Height, that they center all Knowledge in (what they call) *Taſte*, and neglect ſo much the common Duties of Life, and the Practice of Literature in general, that they are Babes in Knowledge at the Age of forty; and nothing can convince them of the Want of it, but their own dear-bought Experience, when having by Extravagancies ran through a genteel Fortune, they very often (too late) find that true Knowledge is as inconſiſtent with Supineneſs and Careleſſneſs, as true Happineſs is with Wickedneſs and Folly.

Tyr. This is very true, Sir, indeed: But pray what do you call true Knowledge, or what Branches of Literature do you call the beſt of Knowledge?

Phil. I am not to determine for you and the reſt of Mankind; becauſe there are many different Degrees of Knowledge, *viz.* a Knowledge of the different Languages, ſuch as *Latin*, *Greek*, *Hebrew*, *&c.* is a fine Qualification, but few are Maſters of it, for Want both of Time and Fortune; and many that have Time and Fortune, are ſo very lame and deficient in their Studies, that they make ſuch a poor Figure in the World, as will not bear an Examination.

Tyr. Very true, Sir: But what elſe do you call that Knowledge which Mankind in general ſhould be acquainted with; for every Perſon has not Time to learn different Languages?

Phil. Why, *Tyro*, the Queſtion is hardly fair, becauſe of the different Opinions and Delights of Mankind. But if I muſt give my Opinion, I think that ſome Knowledge of the *Latin* and *Greek* Languages, (without which we can never be perfect Maſters of our own) with a good Proficiency in Arithmetic, and a reaſonable Purſuit after ſome higher Branches of the Mathematics, ſuch as *Geometry*, *Trigonometry*, *Aſtronomy*, *Algebra*, *&c.* is certainly the beſt and moſt neceſſary temporal Knowledge; becauſe it carries with it the greateſt Satisfaction, built upon Truth itſelf, and leaves not the Mind at all in Doubt and Suſpenſe.

Tyr.

Tyr. It is very true, Sir: But is there no other Knowledge neceſſary to furniſh the Mind with in our early Days?

Phil. Yes; a more neceſſary Knowledge than all the reſt, and to which they ought all to ſubmit, till the Mind is firſt furniſhed with it.

Tyr. What is that, pray?

Phil. An early Knowledge of *God*, as is revealed to us by his divine Law in the Holy Scriptures.

Tyr. I grant, Sir, what you ſay to be true: But you know it is not faſhionable at all, neither is the Knowledge of the Holy Scriptures in any Reſpect counted neceſſary for the Qualification of the Gentleman at this Time of Day.

Phil. It is very true, *Tyro*, indeed; but notwithſtanding this, yet it is evidently plain, that no Man was ever leſs a Gentleman for being virtuous; nor do the holy Scriptures claſh with the common Order of Decency and Good-breeding, by teaching the Rich to know their Dependance, and to be eaſy of Acceſs; and the very pooreſt of all to be humble, eaſy, and content in their Stations, and behave well to their Superiors.

In ſhort, whatever may be thought neceſſary for a *modern* Gentleman, I know not; but I am very ſenſible that the Knowledge of God is a neceſſary Qualification for every Chriſtian and every Gentleman.—The Practice of it is productive of every Thing that is good: It is a Bulwark againſt all Evil; and when it is purſued under a true Senſe of our Duty, (at a proper Time and Manner, according to the Deſign of its divine Inſtitutor) is ſo far from hindering other Things, that it accelerates us in all our lawful Undertakings; and though it will not make a *Fop* of the *modern* Taſte, yet, by teaching us the greateſt *Decency*, it learns us the trueſt *Gentility*, *viz. Humility*.

Tyr. From whence, pray, ariſes the Ignorance of the Knowledge of God, in an Age where every-body has Time and Opportunity both to inſtruct themſelves, or be inſtructed?

Phil. It ariſes from many Cauſes; but the two principal Cauſes are, the Neglect of reading the Word of God, and the cuſtomary (I may ſay faſhionable) Breach

of the Sabbath. The Example being ſet by too many Perſons of all Denominations, the riſing Generation follow them, and few indeed know their real Duty, for Want of knowing their great Obligation to God; and few know God, for Want of attentively reading the holy Scriptures.

Tyr. Very true, Sir: I ſhould be very glad then you would inform me a little more concerning God, his Nature, and Attributes, *&c.*

Phil. With all my Heart.

SECT. II.

Of GOD; *his Eſſence, Attributes,* &c.

Tyr. What is God?

Phil. God is a *ſupreme, eternal, ſelf-exiſtent, neceſſary,* and *independent* Being: The Creator, Preſerver, Governor, and Diſpoſer of all Things, and all Events, both paſt, preſent, and to come *.

Tyr. What do you mean by God's Attributes?

Phil. His Excellencies and Perfections, *viz.* he is *eternal, inviſible, immortal, incomprehenſible, omnipotent, omniſcient,* and *omnipreſent:* He is alſo *all-wiſe, all-powerful, all-knowing*; full of Wiſdom, Power, Juſtice, Mercy, Goodneſs, and Truth, *&c.*

Tyr. What do you mean by being *incomprehenſible?*

Phil. He is a Being ſo great, that he cannot be conceived or comprehended.

Tyr. What do you mean by *omnipotent?*

Phil. Almighty——Having all Things in Heaven and Earth under his Word, Power, and Command.

Tyr. What is to be underſtood by God's being *omniſcient?*

Phil. The Power and Faculty of knowing all, and all Manner of Things that are paſt, preſent, and to come, with the Certainty of their coming to paſs.

Tyr. What is the meaning of *omnipreſent?*

Phil. God's being preſent every where, at all Times, and in all Places.——And this ſhould teach us, *Tyro,* to be very cautious and circumſpect in all our Actions, as all Things, and all the moſt ſecret Actions, Deſigns,

* Rev. i. 8, 11.

or

or Intentions, are naked and open to the Eye of *Him* with whom we have to do.

SECT. III.

Of the Origin of Nature, and the firſt Formation of Things.

Tyr. What do you mean by the firſt Formation of Things; or, how and in what Manner were they created?

Phil. You muſt not expect I ſhould give you a very long Detail of the very firſt Principle of Things: Nor is it indeed neceſſary that I ſhould tell you the different Opinions of the Learned, concerning the active Parts of Matter. It is ſufficient if I tell you their various Opinions, and lead you at laſt into Truth.

Firſt then, *Anaxagoras* affirmed that all Things were formed or generated from ſmall Particles, or minute Corpuſcles of Matter, entirely alike (he ſays, but not how, at firſt, formed); which being amaſſed or joined together, produced or formed all Things.

2. *Ariſtotle* (much later) held not only the ſame Principle of a fortuitous Concourſe of Atoms, but went further, and ſays, the original Cauſe of all Things is from *Matter*, *Form*, and *Privation*; and that the whole Order of Nature is produced by *Chance* *. This his Opinion continued in Vogue a full Century, and even ſome to this Day moſt ignorantly and wickedly adhere to, and ſubmit to this Abſurdity, as much as to the Authority of divine Revelation.

3. *Heſiod*, *Diogenes*, *Heraclitus*, *Hippias*, and *Thales*, help and maintained the four Elements to be the only Principle of all natural Things and created Beings, *viz. Heſiod* ſays, that it was Earth which firſt ſprung from Chaos. *Diogenes* ſays, all Things were formed of Air, which being both ſoft and flexible, is capable of receiving all Shapes.

Heraclitus, *&c.* affirmed, that Fire was the firſt Mover of all Things; and *Thales* and his Followers maintained, that Water was the firſt principal Cauſe. Their

* Of this ridiculous Notion of *Matter* and *Chance*, ſee Part III. under that Head.

different Reaſons for ſupporting either of theſe Arguments are ſo long, contradictory, and ridiculous, that they are better omitted, ſince it is evident neither of them are right, at leaſt all cannot be ſo.

Tyr. Very ſurpriſing, that Men of ſuch Learning ſhould maintain Principles ſo contrary to each other, and to Truth itſelf. But, pray, were theſe the only Men?

Phil. No; many were their Followers, *viz. Anaximenes, Empedocles, Meliſſus, Xenophanes, Archelaus, Zareta, Oenopides, Pythagoras, Mochus, Plutarch, Zeno, Chryſippus, Socrates, Plato, &c. &c.* Some of theſe joined and ſtuck very cloſe to the different Opinions of the firſt, and yet neither two agreed among themſelves concerning the true Cauſe of created Beings, and their Formation, any more than they could afterwards about the *ſummum bonum*, or Chief Good, or the true Object of *Good, Homage, Obedience, Adoration, &c.*

Tyr. You are very kind, Sir: But how am I to diſtinguiſh between *right* and *wrong*, ſince ſuch learned Men as theſe differ ſo much, and each lays down his own Sentiments as Truth?

Phil. Their differing ſo much is a plain Proof there is no Certainty in either of them; and that their Schemes are abſurd, and (upon the whole) inconſiſtent to Reaſon.

Tyr. But what ſurpriſes me is, that even *now* many Men of Learning and good Senſe, follow many of their Principles, in believing the World is eternal, and that Matter always exiſted.

Phil. Very true; too many believe ſo, but did ever any give a Proof of it, either phyſically, or metaphyſically?

Tyr. I do not know: But ſtill, how am I to avoid falling into Error after all?

Phil. Why, *Tyro*, you muſt take Care of every Author, and of every Acquaintance, and be reſolved with yourſelf, not to be ſo far impoſed upon, as to believe theſe Inconſiſtencies; for as it is evident Matter has not a Power to *think*, much leſs has it to *act*, therefore as the Elements could not create themſelves, they muſt have been created by ſome other Hand, who muſt neceſſarily exiſt in and of himſelf, *viz.* God.

Tyr.

Tyr. I thank you, Sir: and it plainly appears to me a Contradiction, for Matter to exiſt of itſelf; and I am ſatisfied that there is one eternal, immortal, and ſelf-exiſtent Being, who not only at firſt created all Things, but that theſe Things which he ſo created, depend alſo upon his Preſervation.

Phil. I ſhould be very glad every Perſon had ſo firm a Belief and Dependance on God; for the very Preſervation of his Church, and curbing or preventing the Deſigns of powerful as well as wicked Men, is a plain Proof of his governing all and all Manner of Events, and that no Purpoſe, Deſign, Contrivance, or Expedition of Man can go beyond the Limits of his Permiſſion——Chance has no real Meaning, is conſiſtent only with its own ſelf, and cannot be defined.

SECT. IV.

Of the Creation, Fall, and Reſtoration of Man.

I. *Of the Image of* GOD *in Man.*

Tyr. What is meant by the Image of God in Man?

Phil. Not Man's bodily Shape, as moſt Perſons ignorantly ſuppoſe——But it was, that he was made by God in the Image of Righteouſneſs and true Holineſs, and therefore like the Creator, like unto God; except in this, that though created an *upright* Man, yet he was but a *finite* Creature, and in Conſequence thereof liable to be deceived.

Tyr. Pray, Sir, give me a further Account of the Advantage of the Image of God in our firſt Parents?

Phil. I will—*Firſt*, Man had a juſt Knowledge of the Nature, Will, and Works of God.——*Secondly*, A Will freely tending to obey God; becauſe his Deſires, Faculties, and Inclinations, were only to God-ward.—*Thirdly*, He had a continual Enjoyment of Peace and Serenity; a Body free from Diſeaſes; and a Soul full of all proper Faculties to enjoy God.——*Fourthly*, He had a full Dominion over all other Creatures, and they were created with a proper Aptitude to obey him.—In ſhort, He was created in ſo happy a State, that there was nothing to hinder him from enjoying God in a continual Series of Felicity and Bleſſedneſs.

" ——— He form'd thee, Adam, thee, O Man,
" Duſt of the ground, and in thy noſtrils breath'd
" The breath of life; in his own image he
" Created thee, in the image of God
" Expreſs" ———

Milton's *Par. Loſt*, B. 7, No. 524.

Again:

" ——————— Thrice happy men,
" And ſons of men, whom God hath thus advanc'd,
" Created in his image, there to dwell
" And worſhip him, and in reward to rule
" Over his works, on earth, in ſea, or air,
" And multiply a race of worſhippers
" Holy and juſt: thrice happy if they know
" Their happineſs, and perſevere upright."

Book 7, No. 625.

Tyr. Bleſſed State indeed—How is it poſſible it ſhould be loſt? Pray give me ſome Account of it, and the Alteration it made in *Adam* and his Poſterity?

Phil. I will.

II. *Of the Fall of Man.*

Tyr. What do you mean by the Fall of Man?

Phil. His changing from, or diſobeying the Command of his Creator, by which he fell from his original State of Righteouſneſs.

Tyr. In what Reſpect?

Phil. In eating of the Fruit of the Tree of Knowledge of Good and Evil—Though he was told—In the Day thou eateſt thereof thou ſhalt ſurely die.

Tyr. What was the Fruit of this Tree?

Phil. No Matter—Some ſay of the Apple Kind—Others ſay *this*, and *that*—But it was not the Fruit, or Sort of Fruit, was the Occaſion of the Fall; but the Act of Diſobedience in eating, or doing *that*, which he was particularly commanded not to do.

Milton finely expreſſes the Folly of *Eve* as follows:

" So ſaying, her raſh hand in evil hour
" Forth reaching to the fruit, ſhe pluck'd, ſhe eat:-

" Earth

" Earth felt the wound, and Nature from her ſeat
" Sighing through all her works gave ſigns of woe,
" That all was loſt."———

Tyr. I underſtand you very well, Sir; and pray inform me what followed this Act of Diſobedience?

Phil. As it is impoſſible to tell the Happineſs of Man firſt created in the Image of God: So it is impoſſible to expreſs the Unhappineſs, in the different Circumſtances and Alterations of the Nature of Man, after he had loſt that Image: For, by this Act of Diſobedience, he brought upon himſelf Sorrow, Labour, Pain, Grief, and continual Vexation of Spirit. He that had once a pure and free Will, an extenſive Underſtanding, a penetrating Judgment, and a tenacious Memory, has not only in a great Meaſure loſt theſe Advantages, but has hereby rendered himſelf obnoxious to God's Diſpleaſure.

" O Eve, in evil hour thou didſt give ear
" To that falſe worm, of whomſoever taught
" To counterfeit man's voice, true in our fall,
" Falſe in our promis'd riſing; ſince our eyes
" Open'd we find indeed, and find we know
" Both good and evil, good loſt, and evil got,
" Bad fruit of knowledge, if this be to know,
" Which leaves us naked thus, of honour void,
" Of innocence, of faith, of purity,
" Our wonted ornaments now ſoil'd and ſtain'd,
" And in our faces evident the ſigns
" Of foul concupiſcence."

Milton, B. 9, No. 1067.

Tyr. What an Alteration did this Act of Diſobedience make in our firſt Parents!

Phil. Alteration indeed, as was ſaid before! All feel the Effects of it, *Tyro*; but how and in what particular Manner every Individual ſuffers by this Conſequence is out of the Power of any Man to determine, and therefore abſurd to attempt it: For ſome ſay, that the Words—*In the Day thou eateſt thereof, thou ſhalt ſurely die*,—extended to the natural Death of *Adam*, his Poſterity, and all Creatures.—Others ſay, that the Word

die, means Death, both temporal and *eternal*, both to *him* and his Poſterity; and others ſay again, that it is inconſiſtent to the Juſtice of God, to ſuppoſe that *he* ſhould charge me with a Part of, or puniſh me for an Offence, that I had no Power to do, nor could poſſibly have the leaſt Hand in, as I did not exiſt when it was committed.

Tyr. But do you not think that this Tranſgreſſion has in ſome Reſpect affected us, and in ſome Meaſure defaced the Image of God in us?

Phil. I own, for my Part, that I believe that this firſt Breach of God's Command, has been the Occaſion of the Diſeaſes and Failings of Mankind; and that by it we are not only ſubject to Death temporal, but that we have in a great Meaſure loſt that clear Knowledge of God which Man once had; and alſo have not that Aptitude to ſerve, honour, and obey him, as *Adam* had; but that of ourſelves, free from the Laws of Education or Revelation, are now more naturally prone to Evil than Good.

Tyr. This is my Opinion, as well as yours, and I think no one can deny it thus far: But pray what is your Opinion concerning the whole Race (Infants not excepted) being obnoxious to God's Wrath, by the Fall?

Phil. I told you before, that I ſhould not enter into negative and cavilling Diſputes concerning Things we know not of, nor have any Right to preſume to determine: I only ſay, that plain it is the Fall of our firſt Parents have acted ſo far upon us, as to make us unwilling of ourſelves to walk in the Ways of true Holineſs; that our Minds are naturally ſet upon Pleaſure and Vanity, rather than Virtue and Sobriety; and that it is evident, that the Bent of our Inclination is rather tending to Folly, and ſuch Things, which in the End will hurt us, rather than to thoſe which would promote and do us Good.——How far Almighty God excuſes us in this Situation, is alſo out of the Power of Man to determine; ſince he only can be, and is, the true Judge of every Action, and every Circumſtance of the various Conſequences and Steps of all Mankind, in all their different States and Capacities.

Tyr.

Tyr. Very true, Sir; but yet you have not ſatisfied me in that Part of my Queſtion concerning the Wrath of God on *Adam*'s whole Poſterity, in which Infants are included.

Phil. How far God, as God, has a juſt Right to inflict the Puniſhment of *Adam* on his Poſterity, I ſaid before, is impoſſible to determine; but if we may judge of it according to his Nature as God, and agreeable to the Goſpel of our Lord *Jeſus Chriſt*, we cannot ſuppoſe that Infants are Objects of eternal Wrath; becauſe we have no Warrantee in Scripture even that hints, that we are immediately accountable to God for the Sins of any other, but only for our own actual Tranſgreſſion of his Laws; and it would be the higheſt Abſurdity to accuſe me of breaking a Law, before a Law was given, and more abſurd to condemn me of a Breach of a Law which I never heard of, nor had Power in Infancy to violate.—I think this is very clear, *Tyro*, from the Laws of right Reaſon, and I am certain it is agreeable to the Precepts and Doctrine of the Prophets and Apoſtles.——Were there no more Proofs of this (as there are many), then the poſitive Words of the Prophet *Ezekiel* would be ſufficient, which I here give you at Length, Chap. xviii. Verſe 20. "The Soul (ſays he), "that ſinneth it ſhall die: The Son ſhall not bear the "Iniquity of the Father; neither ſhall the Father bear "the Iniquity of the Son: But the Righteouſneſs of the "Righteous ſhall be upon him; and the Wickedneſs of "the Wicked ſhall be upon him."

3. *Of Man's Reſtoration.*

Tyr. You have given me great Satisfaction in giving me a full Account of theſe Things in a ſhort Compaſs; but pray, after this Act of Diſobedience, what Hopes had Man to be admitted again to God's Favour?

Phil. He that before ſolemnly declared,—*In the Day thou eateſt thereof, thou ſhalt ſurely die*——Now kindly aſſures them, That the Seed of the Woman ſhall break the Serpent's Head: That is, the Son of God made Fleſh, and born in due Time, ſhould offer up himſelf to God for the Sins of Mankind, and ſhould reſtore him again to Favour, and, in the End, ſhould conquer Death, Hell, and Sin.—

Milton

Milton moſt affectingly ſets out the Juſtice of God being offended with *Adam*'s Sin, and the Manner how that Juſtice was appeaſed.——For God the Father, ſpeaking of the Heinouſneſs of *Adam*'s Crime, ſays, Book iii. No. 210,

" Die he or juſtice muſt; unleſs for him
" Some other able, and as willing, pay
" The rigid ſatisfaction, death for death.
" Say heav'nly pow'rs, where ſhall we find ſuch love?
" Which of ye will be mortal to redeem
" Man's mortal crime, and juſt th' unjuſt to ſave?
" Dwells in all heaven charity ſo dear?
" He aſk'd, but all the heav'nly quire ſtood mute,
" And ſilence was in heav'n: on man's behalf
" Patron or interceſſor none appear'd,
" Much leſs that durſt upon his own head draw
" The deadly forfeiture, and ranſom ſet.
" And now without redemption all mankind
" Muſt have been loſt, adjudg'd to death and hell
" By doom ſevere, had not the Son of God,
" In whom the fulneſs dwells of love divine,
" His deareſt mediation thus renew'd.
" Father, thy word is paſt, Man ſhall find grace;
" And ſhall grace not find means, that finds her way,
" The ſpeedieſt of thy winged meſſengers,
" To viſit all thy creatures, and to all
" Comes unprevented, unimplor'd, unſought?
" Happy for Man, ſo coming; he her aid
" Can never ſeek, once dead in ſins and loſt;
" Attonement for himſelf or offering meet,
" Indebted and undone, hath none to bring:
" Behold Me then; me for him, life for life
" I offer; on me let thine anger fall;
" Account Me Man; I for his ſake will leave
" Thy boſom, and this glory next to thee
" Freely put off, and for him laſtly die
" Well pleas'd; on me let Death wreck all his rage;
" Under his gloomy pow'r I ſhall not long
" Lie vanquiſh'd; thou haſt giv'n me to poſſeſs
" Life in myſelf for ever; by thee I live,
" Though now to Death I yield, and am his due

" All

" All that of me can die; yet that debt paid,
" Thou wilt not leave me in the loathſome grave
" His prey, nor ſuffer my unſpotted ſoul
" For ever with corruption there to dwell;
" But I ſhall riſe victorious, and ſubdue
" My vanquiſher, ſpoil'd of his vaunted ſpoil;
" Death his death's wound ſhall then receive, and ſtoop
" Inglorious, of his mortal ſting diſarm'd.
" I through the ample air in triumph high
" Shall lead Hell captive maugre Hell, and ſhow
" The Pow'rs of darkneſs bound. Thou at the ſight
" Pleas'd, out of Heaven ſhalt look down and ſmile,
" While by thee rais'd I ruin all my foes,
" Death laſt, and with his carcaſs glut the grave:
" Then with the multitude of my redeem'd
" Shall enter Heav'n long abſent, and return,
" Father, to ſee thy face, wherein no cloud
" Of anger ſhall remain, but peace aſſur'd
" And reconcilement; wrath ſhall be no more
" Thenceforth, but in thy preſence joy entire."

Then God anſwers, No. 275.

" O thou in Heav'n and Earth the only peace
" Found out for mankind under wrath, O thou
" My ſole complacence! well thou know'ſt how dear
" To me are all my works, nor Man the leaſt,
" Though laſt created; that for him I ſpare
" Thee from my boſom and right hand, to ſave,
" By loſing thee awhile, the whole race loſt.
" Thou therefore, whom thou only canſt redeem,
" Their nature alſo to thy nature join:
" And be thyſelf Man among men on earth,
" Made fleſh, when time ſhall be, of virgin ſeed,
" By wondrous birth: be thou in Adam's room
" The head of all mankind, though Adam's ſon.
" As in him periſh all men, ſo in thee,
" As from a ſecond root, ſhall be reſtor'd
" As many as are reſtor'd, without thee none.
" His crime makes guilty all his ſons; thy merit
" Imputed ſhall abſolve them who renounce
" Their own both righteous and unrighteous deeds,
" And live in thee tranſplanted, and from thee

" Receive

" Receive new life. So man, as is moſt juſt,
" Shall ſatisfy for Man, be judg'd and die,
" And dying riſe, and riſing with him raiſe
" His brethren, ranſom'd with his own dear life.
" So heav'nly love ſhall outdo helliſh hate,
" Giving to death, and dying to redeem,
" So dearly to redeem what helliſh hate
" So eaſily deſtroy'd, and ſtill deſtroys
" In thoſe who, when they may, accept not grace.
" Nor ſhalt thou, by deſcending to aſſume
" Man's nature, leſſen or degrade thine own.
" Becauſe thou haſt, though thron'd in higheſt bliſs
" Equal to God, and equally enjoying
" God-like fruition, quitted all to ſave
" A world from utter loſs, and haſt been found
" By merit more than birthright Son of God,
" Found worthieſt to be ſo by being good,
" Far more than great or high; becauſe in thee
" Love hath abounded more than glory abounds,
" Therefore thy humiliation ſhall exalt
" With thee thy manhood alſo to this throne;
" Here ſhalt thou ſit incarnate, here ſhalt reign
" Both God and Man, Son both of God and Man,
" Anointed univerſal king; all power
" I give thee; reign for ever, and aſſume
" Thy merits; under thee as head ſupreme
" Thrones, Princedoms, Pow'rs, Dominions I reduce;
" All knees to thee ſhall bow, of them that bide
" In Heav'n, or Earth, or under Earth in Hell.
" When thou attended glorioufly from heav'n
" Shalt in the ſky appear, and from thee ſend
" The ſummoning Arch-Angels to proclaim
" Thy dread tribunal; forthwith from all winds
" The living, and forthwith the cited dead
" Of all paſt ages, to the general doom
" Shall haſten, ſuch a peal ſhall rouſe their ſleep.
" Then all thy ſaints aſſembled, thou ſhalt judge
" Bad men and Angels; they arraign'd ſhall ſink
" Beneath thy ſentence; Hell, her numbers full,
" Thenceforth ſhall be for ever ſhut. Mean while
" The world ſhall burn, and from her aſhes ſpring
" New Heav'n and Earth, wherein the juſt ſhall dwell,

" And

" And after all their tribulations long
" See golden days, fruitful of golden deeds,
" With joy and love triumphing, and fair truth.
" Then thou thy regal ſcepter ſhalt lay by,
" For regal ſcepter then no more ſhall need,
" God ſhall be all in all. But all ye Gods,
" Adore him, who to compaſs all this, dies;
" Adore the Son, and honour him as me.
" No ſooner had th' Almighty ceas'd, but all
" The multitude of Angels, with a ſhout
" Loud as from numbers without number, ſweet
" As from bleſt voices, uttering joy, Heav'n rung
" With jubilee, and loud Hoſanna's fill'd
" Th' eternal regions: lowly reverent
" Tow'rds either throne they bow, and to the ground
" With ſolemn adoration down they caſt
" Their crowns."——

Here you have the bleſſed Spirits praiſing and adoring God the Father, and the Son, for this wonderful Redemption and Reſtoration. And *Adam* himſelf, after the Arch-Angel *Michael* had told him of the Syſtem of this Redemption, ſays, Book xii. No. 469.

" O Goodneſs infinite, Goodneſs immenſe!
" That all this good of evil ſhall produce,
" And evil turn to good; more wonderful
" Than that which by creation firſt brought forth
" Light out of darkneſs! full of doubt I ſtand,
" Whether I ſhould repent me now of ſin
" By me done and occaſion'd, or rejoice
" Much more, that much more good thereof ſhall ſpring,
" To God more glory, more good will to men
" From God, and over wrath grace ſhall abound."

Thus you read concerning the Redemption, and after *Chriſt* the Deliverer was aſcended up to his Father, having compleated his Office.——Then you read concerning the ſending of the Comforter, or Holy Spirit, to aſſiſt Man in his Warfare.

Tyr. Moſt excellently fine indeed!

Phil. If you can read Blank Verſe, there is no Book that I would recommend to you preferable to *this*, as an Accom-

Accompanyment to the Word of God itſelf: Here, my dear *Tyro*, you will ſee the Creation and Fall of both Angels and Men——The Ignorance of Man after the Fall, how they worſhipped various Deities.—You have alſo a beautiful Proſpect of the various Acts of Providence in all Parts of the Creation, in Earth, Air, Fire, and Water. In ſhort, you have every Thing ſet forth whereby the Creature may have a very juſt Notion of the Greatneſs of his Creator's Power, Wiſdom, Juſtice, Mercy, and Truth, agreeable to the plain and ſimple Doctrine of the Goſpel of our Lord *Jeſus Chriſt*, without any whimſical Syſtems of modern Diſputants, or the old unconnected Suppoſitions and arbitrary Doctrines of ſome of the Fathers.

Tyr. I ſhall endeavour to take your Advice.

Phil. Do ſo, *Tyro:* You'll not repent it in the End, when, by your conſtant Search after Truth, you find the greateſt Satisfaction that can be wiſhed for: Nay ſuch a Satisfaction, that partial Men, who take up their Faith purely upon Cuſtom, or wholly from the Belief of any Man, or Sect of Men, never can arrive to. If the Apoſtle St. *John* gave a Charge to his Followers to ſearch after Truth, certainly *we* have the ſame undoubted Right from his Authority, and not to take our Faith upon Truſt.

Tyr. It is very true, Sir; but there are ſo many contrary Opinions among the Learned, not only of the different Sects, but even thoſe of the ſame Perſuaſion, that it is impoſſible to pleaſe them all.

Phil. Very true; but I will tell you how you may prevent affronting any, except the *obſtinate*, *bigotted*, and *dogmatical*.

Tyr. I ſhould be glad of this.

Phil. In all curious Queſtions, and ſpeculative Surmiſes and Curioſities, if they have the Probability of, it may or may not be; wave the Matter, rather than hold an unneceſſary Diſpute.——But whoever impoſes upon you any Article of Faith, though he pretends to the Sanction of any Man, Church, Nation, or People, who have no other Authority but Cuſtom, or the Tradition of their Fore-Fathers, to ſupport it, let not that at all bias *you*, except ſuch Article of Faith runs parallel with,

with, and is agreeable to the Word of God itſelf: And ſhould any ſuch Article be inconſiſtent, not only to the Word of God, but common Senſe and Reaſon, (ſuch as the Doctrine of Tranſubſtantiation, *&c. &c.*) then it is your Duty to proceed further, according to your Knowledge, Power, or Ability: That is, not only to deny it, but to oppoſe it at all due Times and Places.—But herein I would be underſtood, that you are not to oppoſe for Oppoſition's Sake, but with a modeſt Boldneſs mixt with every Mark of Love and Tenderneſs, Benevolence and Impartiality: Theſe added to, or accompanied with Knowledge, ſeldom fail not only to conquer, but even to cauſe thoſe whom you have conquered to love you: For nothing, *Tyro*, is ſo great a Sign of Weakneſs, or a Man's having the wrong Side of an Argument, as his being obliged to fly to the rotten Pillars of Anger, Ridicule, and Over-Bearingneſs, the conſtant and inſeparable Companions of Ignorance, the Props of Falſhood, and the Bane of Truth.

Tyr. I have been Eye Witneſs many Times to the Truth of what you aſſert.

Philo. If ſo, you are inexcuſable not to ſearch more and more after true Knowledge: For the nearer you approach to the Truth of ſuch Things as are, firſt of all, plainly ſet forth in Holy Writ, and agreeable, at the ſame Time, with the natural Laws or Axioms of Reaſon itſelf, the more and more will you receive Satisfaction; and it will be ſuch a Pleaſure and Satisfaction indeed, that will be out of the Power of Mankind to deprive you of.

Tyr. You may depend upon my obſerving well what you ſay.

Phil. That is all I deſire; and therefore I ſhall ſay no more upon this Head, only leave the ſame Advice with you as *Michael* the Arch-Angel left with *Adam*, after he had been ſhewing him the wonderful Works of his Creator, and his due Obedience to him:

" This having learn'd, thou haſt attain'd the ſum
" Of wiſdom; hope no higher, though all the ſtars
" Thou knew'ſt by name, and all th' ethereal pow'rs,
" All ſecrets of the deep, all Nature's works,

" Or

" Or works of God in Heav'n, air, earth, or ſea,
" And all the riches of this world enjoy'dſt,
" And all the rule, one empire; only add
" Deeds to thy knowledge anſwerable, add faith,
" Add virtue, patience, temperance, add love.
" ——————Then wilt thou not be loth
" To leave this paradiſe, but ſhalt poſſeſs
" A Paradiſe within thee, happier far."

But let us return to, and conſider again, the Exiſtence and Attributes of the Almighty. You muſt know then, that Man only, of all other Beings, is able to make a Diſcovery of a *firſt Cauſe*, *the great Author and Maker of all Things*, and which by us is called GOD.

And as the *whole Frame and Order of Things*, *which we behold*, is what we call *Nature*; ſo that Act of the Mind whereby we conſider and compare Things, according to their *various Natures* and *Relations*, and deduce from thence the *Exiſtence of a God*, is what we call *Reaſon*. And the Arguments and Motives which are afforded us from the View and Proſpect of Nature in her ſeveral Parts, and whereby we are induced and inclined to give our Aſſent to the Doctrine of the Being of a God, is what we call the *Light of Nature*.

And e'er we reckon ſix, eight, or ten Years from our Births, we are able, in ſome Degree, to exert this noble Faculty of Reaſon, and make ſome Progreſs in the divine Diſcovery aforeſaid, *viz.* of *God's Exiſtence* and moral Qualities: And this Faculty of Reaſon, as we grow in Years, becomes more ſtrong and perfect, and works on the pure and untainted Mind with native Force, and ſuch powerful and clear Proof, as we can neither deny nor withſtand. And thus, as Saint *Paul* has obſerved, what is neceſſary to be known of God, (or indeed can be known of him by us) is manifeſt in the Works of the Creation; even his eternal Power and Godhead is clearly ſeen, being underſtood by the Things which are made. So that all Perſons, capable of Reaſon, are without Excuſe, who do not readily acknowledge the Being and Glory of Almighty God.

Nor is there any Part of Nature within our View, (nor any Place where there is not ſuch a View of Nature),

ture) which doth not loudly call upon us to receive and confeſs this great and divine Truth. The Heavens declare the Glory of God; and the rich Furniture thereof, the Sun, the Moon, and Stars, ſhew themſelves to be his Handy-Work: Day unto Day uttereth Speech, and Night unto Night ſheweth Knowledge. There is no Nation on the Face of the whole Earth, where their Voice is not heard; for it is gone thro' all the Earth, and their Words to the End of the World.

We ſee all Things conſiſt of Matter, which is for the moſt Part obvious to our Senſes; and we are moſt agreeably ſurpriſed with a wonderful and infinite Variety of Forms, Conditions, and Qualities of natural Subſtances. Some Parts of Matter we obſerve to be without Motion, Senſe, or Life, as *Stones* and *Earth*: Others we ſee are endued with a Power of growing and extending themſelves into ſpecial Forms and Sizes, as *Herbs* and *Trees*, which therefore have innate Motion, and may, in ſome Senſe, be ſaid to live or have Life, though in the loweſt Degree. The next Claſs of Beings which preſent themſelves, is in a Degree much ſuperior to the foregoing, the Subjects of which are all endued with native Motion, Life in the moſt perfect Degree, and the Quality of Senſation; that is, they are capable of *Seeing*, *Hearing*, *Taſting*, *Smelling*, and *Feeling*, of all thoſe Objects which come within the Reach of any of theſe *five Senſes*. Theſe Creatures are therefore called *Animals*, becauſe they have the *Faculty of Life*, or are endowed with a *living Soul*.

But Man alone is capable of uſing his Reaſon to the nobleſt Purpoſes, to wit, the finding out the Being and Perfections of God, his Providence, and the Certainty of a future State after Death. For he can thus reaſon or argue: Every Thing that is, or doth exiſt, receives its Being either from itſelf, or ſome other Principle or Cauſe; but nothing can be the Cauſe of itſelf, for that implies, that while it is not, it is capable of acting, or producing its own Being, which is evidently abſurd; therefore it muſt receive its Being from without itſelf, or from ſome other Cauſe different from itſelf; and this firſt Cauſe we name GOD. And this Reaſoning holds good of all the various Kinds of Beings yet obſerved,

and

and even of Man himſelf, the chief of all: For nothing is more certain, than that the Power of giving or retaining Life, either in himſelf, or any other Creature, is not in Man, and conſequently in no other Being but God himſelf.

But more particularly, the Being of a God is evident from the bare Conſideration of the Properties of Matter: For Matter, it is plain, is of itſelf not capable of Motion or Reſt, but is entirely liſtleſs and indifferent to both. But ſince all the Animal Creation is endowed with the Power to move or reſt at Pleaſure, 'tis evident this Faculty is not from Matter itſelf, of which alone all Things conſiſt; therefore it muſt be from ſome other Principle or Cauſe, *viz.* from God.

This is moſt certainly evident from the abſolute and conſtant Motions of the heavenly Bodies, which ever keep turning round one common Centre in Orbits nearly circular. For ſince theſe Bodies, I mean the Planets, are only huge Maſſes of mere Matter, they are not of themſelves capable of any Motion at all; therefore they were firſt ſet in Motion by ſome firſt Mover, which is able to communicate that Power to Matter; which is God only, as before proved.

But this is ſtill more obvious from the Manner of their Motions, which is circular; for when Matter is put into Motion, it naturally proceeds in a direct or right Courſe; that is, ſtrait forwards, and not in a crooked or circular Courſe or Orb, as the Planets all do. Now the Air is not of that Thickneſs or Denſity in thoſe Regions, as to ſtop the rapid Courſe of ſuch great Bodies, and turn them from a direct to a curve or circular Motion; but ſince it cannot proceed from the Air, it muſt be the Reſult of ſome Cauſe in thoſe Bodies themſelves, and that is Gravity, whereby they tend to their common Center of Motion from a right Courſe, yet ſo adjuſted, with reſpect to the Force of the firſt or direct Motion, that together they form the circular Courſe; and ſo neither fly off in right Lines to infinite Diſtances, nor fall at once to the Centre, and there loſe all Motion. Now all this moſt admirable Power and Contrivance plainly points to that great Author, of whom

whom the *Heavens are the Works of his Fingers, and the Moon and Stars are of his ordaining.*

From the Conſideration of *final Cauſes* flow a thouſand Arguments to prove the Exiſtence of God. By *final Cauſes*, I mean the Ends for which Things are evidently made, or intended to anſwer. Thus when we conſider the Light was created to render Things viſible, the Eye made on Purpoſe to behold them; when we conſider the Air as a Means to convey Sounds and Scents, and the Ears and the Noſe made and contrived on Purpoſe to hear and ſmell the ſame: That in the Body there are Nerves which convey the Ideas received by thoſe outward Organs of Senſe to the Brain, which is the Seat of the Mind in Animals, to be there made Uſe of for the Service, and at the Diſcretion of the Creature, in the ſeveral Occaſions of Life: I ſay, when we conſider ſuch a wonderful Furniture of Means appointed ſo evidently to anſwer ſuch a Series of proper and neceſſary Ends, it forces our Aſſent to the Doctrine of a Deity, who alone can be ſuppoſed capable of performing ſuch wonderful Things.

Again: From a due and nice Examination of all the larger Parts of the Creation, ſuch as the Globe of Earth on which we live, the great Variety of its Produce in Animals, Plants, and Minerals; the exact Contrivance of Animal Bodies to ſuit them for the Medium in which they live; the Man, and larger Beaſts for Land, the Fiſhes for ſwimming in Water, the Fowls for flying in Air, the infinite Species of Creatures for the dark Abodes within the Body of the Earth; the rich and beautiful Variety of Herbs for the Paſturage of the Beaſts, and Service of Man; with all the mineral Tribes in the Bowels of the Earth; the great and uſeful Variety of Mountains, Valleys, Rivers, Springs, *&c.* with which its Surface is diverſified: As they all jointly ſerve the Uſes and Neceſſities of Mankind, ſo they call moſt emphatically upon us to acknowledge and adore the divine Author, for diſplaying and expending ſo much of his boundleſs Power and Providence in our Behalf. In like Manner, the wonderous Orb of Air ſurrounding the Earth, ſerving to the Generation of Winds, Rain, Luſtre of Day-light, *&c.* abſolutely neceſſary to the State

State of Man and Beaſts: Alſo the whole Frame and Structure of the Heavens; the Sun which rules by Day, and the Moon which rules the Night, with the Stars alſo, will unavoidably induce us to confeſs, that 'tis *GOD who hath laid the Foundation of the Earth, and that the Heavens are the Work of his Hands.*

From the foregoing Arguments, and many others, 'tis evidently proved *there is a God*; and not only that, but we may from thence, and by the ſame Method of Reaſoning, plainly diſcover and infer moſt of his Attributes and Perfections, which render him, to us his Creatures, an *awful* and *adorable Object.* As firſt, that God is a neceſſary, ſelf-exiſtent and eternal Being; that he is an Unchangeable and Independent Being; that he is but One; that he is a Being moſt Simple, Uniform, Indivifible, and Incorruptible; that he is Omnipotent, or All-powerful; Omniſcient, or infinite in Knowledge; that he is a Pure Spirit, acts freely as he pleaſes, without Neceſſity; and laſtly, that he muſt neceſſarily be a Being of infinite Goodneſs, Mercy, Juſtice, and Truth, and all other moral Perfections; ſuch as become the ſupreme Ruler and Judge of the World.

The Providence of God is moſt rationally inferred from his being proved the Author or Maker of the World, and all Things therein. For not only Man, as being endowed with Underſtanding and Wiſdom, but even Birds, Beaſts, Inſects, and all Creatures having Life and Senſe, we conſtantly obſerve to have a ſpecial Care, Regard, and Tenderneſs of their Offspring; and as it is a Part of natural Goodneſs, can we, on any Account, ſuppoſe the ſame Carefulneſs and providential Regard to the Works of his Hands, wanting in that great Being whom we grant to be poſſeſſed of infinite Goodneſs, Mercy, and Benevolence? But this is directly proved from the ſeveral Obſervations on the Works of Nature, as the Motions of the heavenly Bodies, contrary to the proper Laws of Nature, *&c.* to anſwer a general End. Wherefore we muſt conclude, that the ſame God who created all Things, and upholds and preſerves them by his continual Concourſe, does alſo, by his all-wiſe Providence, conſtantly govern and direct the Iſſues and Events of Things, takes Care of this

lower

lower World, and of all, even the ſmalleſt Things therein; diſpoſes Things in a regular Order and Succeſſion in every Age from the Beginning of the World to its final Period; but inſpects, with a more particular Regard, the moral Actions of Men.

A fuller State of Rewards and Puniſhments may be concluded alſo by the Strength and Light of Reaſon. For, (1.) The Nature of Man is ſuch, that he acts freely, of choice, and unconſtrained; and hath a Law imprinted in his Mind, which conſtantly directs him to do that, in every Caſe, which is fit and requiſite from the Nature of Things. If he acts agreeable to this Law of right Reaſon, it is reputed *Virtue*; if contrary to it, it is called *Vice:* But Virtue merits Reward, and Vice Puniſhment, from the Nature thereof: Yet theſe Rewards and Puniſhments, 'tis plain, are not equally diſtributed in this Life; and ſince they are from God, to whom alone Man can be accountable for his moral Actions, and he is infinitely juſt, it follows there muſt be another and future State, in which Virtue and Vice muſt receive a perfect and equitable Diſtribution of Rewards and Puniſhments, proportionable to the ſeveral Degrees of Merit and Demerit. (2.) From the natural Inclination and Deſire of Immortality, and an unavoidable Concern for what is to come hereafter, implanted in all Men, we may very probably conclude a future State. (3.) The Dignity and Excellency of Man's Nature plainly ſhew him deſigned and intended for a better and more worthy State of Life, than the beſt he can enjoy in this World. (4.) The natural Self-conſciouſneſs and Judgment which all Men ſecretly make of their own Actions in their own Minds, is by all allowed to be no ſmall Proof of a future State of Account. (5.) It hath been the confeſs'd Judgment and Opinion of almoſt all the Heathen World, and has obtained as univerſally, both as to Time and Place, nearly as the Notion of a God itſelf; and therefore muſt be the Reſult of Reaſon, and deem'd a Certainty.

Having eſtabliſhed in the Mind a firm and rational Belief of a Deity, his Providence and Government of the World, and a future State of Life, there muſt neceſſarily enſue the *Practice of Piety*, or an effectual Senſe

Senſe of the Obligations we are under to love, fear, ſerve, praiſe, pray to, and adore the ſacred Name, and glorious Majeſty of God. From hence alſo we are induced to truſt in, to rely and depend upon him; to exerciſe Patience and Hope in Times of Affliction and Adverſity, and to keep ourſelves humble in Times even of the greateſt Proſperity and Felicity; to have always a due and ſolemn Regard to the Rectitude of all our Actions; and to be always in a proper Degree of Reſignation both of ourſelves and Fortunes, to the ſovereign Diſpoſal and Pleaſure of God, who tho' he be the Moſt High, and has Dominion over all, yet he is righteous in all his Ways, and his tender Mercies are over all his Works.

THE

THE YOUNG MAN's Book of Knowledge, &c.

PART II.

Of THEOLOGY.

SECT. I.

Tyro. WHAT is *Theology?*

Philo. Theology ſignifies *Divinity*, and is that Science, whoſe Doctrine treats of, and inſtructs us in the Knowledge of God and the Practice of Religion. *Theology* is divided into five Parts, viz. *Natural*, *Supernatural*, *Moral*, *Poſitive* and *Scholaſtic*.

Tyr. What do you mean by *natural Theology?*

Phil. Natural Theology is that which treats of the Exiſtence of God, and the Works of Creation, as far as is diſcovered by the *Light* of Nature.

Tyr. What is *ſupernatural Theology?*

Phil. Supernatural Theology is the Will of God communicated or revealed to Mankind by Revelation, by which we not only know more of God than by natural Reaſon only, but are more particularly bound by Obligation to perform our Duty to him as a Lawgiver; he having revealed ſuch Things to us that never could have been diſcovered by all the natural Reaſon of Man, nor even by the Conception of Angels. But I will not prevent you, *Tyro*, at preſent, as I ſhall give you a fuller Account of this by and by; therefore pray go on in your Enquiry.

Tyr. What is *moral Theology?*

Phil. Moral Theology is *that* which inſtructs us in that Part of the divine Law, which tends to the Well-being of

Society in general, and the more particular Behaviour, Carriage, Duty or Deportment to each other in particular, in the different Callings, Variations and Circumſtances of Life, either as Superior, Equal, or Inferior.——This, therefore, runs parallel with the Laws of revealed Religion, and comes under that Head.

Tyr. What is *poſitive Theology?*

Phil. Poſitive Theology is the Opinion of the Fathers of the Church concerning the Holy Scriptures.—Or, in other Words, it is that which obliges us to think of, and believe the Interpretation of the Sacred Writings, according to the Opinions, and agreeable to the Sentiments of the antient Fathers of the Church, be it right or wrong.

Tyr. What is *Scholaſtic Theology?*

Phil. Scholaſtic Theology is that which derives its Arguments from certain Rules of Reaſoning, and teaches us Religion, from ſome eſtabliſhed Opinions, Articles or Matters of Faith.

Tyr. I perceive then, that all of theſe may be comprehended under *natural* and *ſupernatural* Religion.

Phil. They may ſo.

Tyr. But I ſhall be obliged to you, kind *Philomathes*, to give me a fuller Account of *natural* and *ſupernatural* Religion, with Reſpect to the different Ends they tend to.

Phil. I will.

SECT. II.

A farther Account of the Religion of Nature.

Tyr. Is Man capable of knowing God by the Light of Nature or Reaſon only?

Phil. Moſt certainly he is, as far as relates to the Works of Creation and Providence. For God having created Man with a Power or Faculty of reaſoning, reflecting and conſidering; Man muſt of Neceſſity, as it were, acknowledge, that there is certainly ſome firſt Cauſe; and if he uſes his Reaſon, and further contemplates the Works of Nature, he cannot help at laſt to own and confeſs the Exiſtence of a God.

Tyr. But there are ſome Perſons that either think not at all, or elſe ſpeak againſt their own Conſcience and the

the very Dictates of Nature, elſe whence comes the *Atheiſt*, who ſays there is no God?

Phil. Though there are ſuch Men, who have boldly denied the Exiſtence of God, yet there never was, nor is there now ſo many of this Stamp as is commonly reported: And in my Opinion, I cannot conceive there can be an Atheiſt, any more than I can be perſuaded that the Prieſts, Fryars, *&c.* of the Church of *Rome* do themſelves really believe the inconſiſtent Doctrine of *Tranſubſtantiation*. For though it is very natural to ſuppoſe, that every Man, of Courſe, believes *that* which he himſelf daily preaches up and propagates, yet we daily find it is not ſo; for it is often done out of a deceitful, wicked, and deviliſh Cuſtom and Infatuation, to ſerve ſome worldly Ends, or ſiniſter Views and Deſigns.

Tyr. I believe what you ſay is true: But pray, is the Light of Nature ſufficient to convince us of the Exiſtence of a ſupreme Being?

Phil. Yes, in many Reſpects, would Man but follow its Dictates, and reflect: For, (1.) Nature itſelf. (2.) The Order of the heavenly Bodies. (3.) The Power, Nature, and Faculty of various Animals. (4.) Their Aptitude to Man. (5.) The vegetable Creation. (6.) Matter itſelf, *&c.* all loudly proclaim the Exiſtence of an almighty, all-wiſe, and all-powerful God.

Tyr. Very true indeed; and pray does not Nature alſo inſtruct us to honour, reverence, worſhip, and fear this our Creator, and do Juſtice one to another?

Phil. Nature, no Doubt, inſtructs us, that there is not only a divine Being who created us, but that we ſhould alſo worſhip and adore him; but how, and in what Manner it is to be done, and how Men are to act in reſpect to God and each other, in what is now called moral Acts, Nature has not ſo well provided for, and Reaſon alone, before revealed Religion, always fell ſhort of it; there being no Law previous to the Law-Giver; and 'tis abſurd to ſuppoſe one Man's Rules or Laws ſhould be binding to another, abſtracted from the Laws of their Creator.

It is plain therefore, that natural Laws, built only upon natural Reaſon, are quite different from the poſi-

tive Laws of the Creator himſelf; God having revealed his Will to Man, and given him Rules to walk by, to the End he might glorify God, and enjoy him for ever. This, Nature itſelf has not Power to do.

SECT. III.

Shewing that the ſuppoſed Laws of Nature and Reaſon cannot be binding, without ſome poſitive Law from a ſuperior primary Being.

Tyr. You have already ſhewn me, that by the Light of Nature only Man may be convinced there is a divine Being; and that if he exerciſes his Reaſon, he will naturally be led to think, believe, and confeſs, that this Being is the greateſt Object of his Adoration.

Phil. Very well, I have ſo—What then?

Tyr. Why you puzzle me when you ſaid the Laws of Nature are not binding to us, reſpecting moral Good and Evil.

Phil. Don't miſtake me, dear *Tyro*; when I ſpeak of the Nature, or the Dictates of Nature only, I would be underſtood thus: That natural Reaſon itſelf is ſo far from regulating our Actions, that without there had been ſome Law or Rules promulgated by a Law-Giver, Men would have been continually ſtriving for a Maſtery, and involved in perpetual Confuſion; becauſe Nature, of itſelf, tells me, I have as great a Right to command or preſcribe Laws for you, as you have for me; and when you ſpeak of Nature only, there can be no Superiority, conſequently then all Subordination ceaſes, all being upon a Level before ſome Law was given; and as for the Origin of moral Good and Evil, Dignity of human Nature, *&c.* they are not to be defined by the Light of Nature, being abſtract Ideas built only upon Hypotheſis, and the conſtant contradictory Opinions of Men, both antient and modern, as you will ſoon ſee hereafter.

Tyr. You are very ſmart upon me, *Philomathes*:—But pray give me Leave; — Does not the Light of Nature teach us the Origin of moral Good and Evil, and that Man being the Head of the Creation, ſhould act according to the Dignity of his Nature?

Phil.

Phil. You aſk the Queſtion with ſuch Earneſtneſs, I cannot help ſmiling; becauſe I perceive plainly that you have blended Part of ſupernatural with natural Religion; but I told you before, that we are now ſpeaking of all ſuch Nations or Individuals, who never had, or have yet received, any Laws or ſuperior Rules or Commands to walk by.

Tyr. I ſhall be obliged to you to inſtruct me further on this Head; but I always thought, that Man's chief Happineſs conſiſted in following the pure Dictates of Nature, and his own natural Reaſon—If I am wrong, pray convince me?

Phil. I won't promiſe to do that; but I will endeavour to prove that the Dictates of Nature, abſtracted (as I ſaid before) from poſitive Laws, never were capable of inſtructing us, much leſs of binding us to this or that particular Duty; nor can it be ſuppoſed, we ſhould have known wherein our real Happineſs conſiſted, had it not been for a ſuperior Evidence.

Tyr. Can you prove what you aſſert?

Phil. Very eaſily: For the Schoolmen themſelves never knew what they meant concerning the Origin of moral Good and Evil, nor could they define it: Neither did they ever agree rightly concerning the *Summum Bonum* itſelf, though in the Schools of *Greece* (as *Varro* and others affirm) there were above two hundred Perſons daily diſputing upon, and as often diſagreeing in their Judgments concerning this and many other Things.

Tyr. What did they uſe to ſay concerning Man?

Phil. They tell us that Man is a noble Creature, that he has a penetrating Judgment, a capacious Underſtanding, and a tenacious Memory, &c. and therefore he ſhould act according to the Dignity of his Nature, and purge his Soul from all Impurities; and then he will become a terreſtrial God, &c. But what of all this, ſuppoſe I was minded to act contrary to what they call the Dignity of my Nature, what then?

Tyr. Why, then, certainly you would do wrong, and muſt give Account of, and be anſwerable for it.

Phil. I thought you would ſay ſo—But this is abſurd, and is of itſelf a ſelf-evident Contradiction—becauſe

Nature and Reaſon have no binding Laws: If ſo then, Whoſe governing Authority have I contemned? or whoſe, or what Law have I broken? I cannot then be guilty of a Fault in diſobeying a Command or breaking a Law, before I knew there was a Law-Giver; nor can I, by the ſame Reaſon, be guilty of any moral Turpitude, without breaking ſome Law or Command, which I was previouſly enjoined to keep.

Tyr. I muſt own, Sir, your Argument has great Reaſon in it, and I begin to ſee more plainly the Truth of what you firſt aſſerted. I ſhould be glad, however, if you could inſtruct me further on this Subject, that I may be yet more capable to ſupport the Argument myſelf, and inſtruct others.

Phil. There remains very little more to be ſaid on this Head, except it be to point out to you the Difference between negative and natural Laws, and poſitive obligatory Laws. Therefore, from what has already been ſaid, the following Axioms, or ſelf-evident Truths, and Obſervations, may eaſily be deduced.

AXIOM I.

No Law laid down or preſcribed by any one Man for another to act by, can poſſibly be binding, one having the ſame Right by the Laws of Nature as the other to preſcribe Laws alſo.

AXIOM II.

Natural, inherent, or intrinſic Good and Evil, Dignity of Nature, *&c.* abſtracted from the Laws of real Obligation from ſome ſuperior Law-Giver, are at beſt but Words without Meaning, and only Chimeras of Imagination, built upon nothing elſe but the ſandy Foundation of idle Fancy and inconſiſtent Ideas

AXIOM III.

Since the Law of Man, abſtracted from ſome divine Law, cannot be obligatory; it will naturally follow, that God, as Creator, has an indiſputable Right of Proprietorſhip; and therefore, he not only created Man fit to be ruled and to rule, but has himſelf given Laws, and ſignified to us that Man muſt of Neceſſity be ſo ruled in Subordination to his Will. Hence follows,

AXIOM

AXIOM IV.

The Foundation of moral Good and Evil ariſes only from the preceptive and prohibiting Will of God, made known to Man; God having given him Laws to walk by, which tend both to his own Glory and Man's greateſt Happineſs; and therefore no one Man has a Right to force another to aſſent to his particular Notions, it being not only contrary to the Laws of his Creator, but is alſo a Violation of the Laws of right Reaſon, and a bare-faced Inſult offered to the Underſtanding.

Tyr. I ſincerely return you Thanks, dear *Philomathes*, and am now fully ſatisfied of the Truth of what you have aſſerted.

SECT. IV.

A further Account of ſupernatural Theology, by which the Will of God was more particularly revealed to Man, and Man more particularly bound to believe and obey him.

Tyr. What do you fully mean by *revealed Religion?*

Phil. Revealed Religion is the Manifeſtation of the Will of God, made known to Man by Revelation, concerning his Son Jeſus Chriſt, coming in the Fleſh, taking our Nature upon him, dying for our Sins, and riſing again for our Juſtification.

Tyr. How was this made known?

Phil. Sometimes by *Viſion* or *Inſpiration*, and ſometimes by ſpeaking to Man, as it were, Face to Face, communicating to him not only Things which are preſent, but thoſe which are paſt and to come, and that never could have entered into the Mind of Man to conceive of, much leſs to tell the very Time of ſuch future Events and Viciſſitudes, which ſhould happen or come to paſs to his own Church, and to the different States and Nations, and this with an infallible Certainty; as witneſs, *Jacob*, *Moſes*, *Iſaiah*, and all the Prophets, whoſe Predictions did certainly come to paſs, as are plainly ſet forth, not only by the Apoſtles, who were endowed with a peculiar Inſpiration, but the Accompliſhment or the Truth of ſuch Prophecies were well known to the Jews themſelves, and have been acknow-

ledged by *Joſephus* and many other Hiſtorians at that Time.

Tyr. Theſe Things are ſo evident, that certainly no body can doubt of the Truth of them.

Phil. One would think ſo, indeed, but yet, you are very much miſtaken; for we have Numbers of *deiſtical* Perſons among us, who lead their Lives and Converſation with due Regard to all the Rules of Morality; and yet are Captains over the Armies of ſuch as deny Revelation and all revealed Religion; and not only laugh at all the ſacred Writings of the Apoſtles and Prophets, but take a Delight to ridicule thoſe who believe them, and with a ſeeming Surprize will tell you, That they thought you were a Man of better Senſe, than to be led aſide with ſuch bugbear prieſt-craft Stories, that are ſo contradictory to Reaſon itſelf, *&c.*

Tyr. Why, you ſurprize me, *Philomathes:* Certainly there cannot be ſuch a Set of Wretches mixt with the Profeſſors of Chriſtianity!

Phil. Moſt certainly there is; and therefore all Chriſtians of every Sect and Denomination, ſhould be upon their Guard, and ſhould take Care to furniſh themſelves with ſufficient Knowledge to withſtand ſo dangerous and inſinuating an Enemy.

Tyr. Very true, Sir; but it is ſurprizing to me, that Perſons who pretend to Morality ſhould rail againſt the Scriptures; ſince no Writings ever penned, treat ſo much and ſo clearly of all the relative Duties of King and Subject, Parents and Children, Maſters and Servants, as they do; beſides enforcing the Obligation we are under (as you obſerved before) to a divine Law, in diſcharging ſuch Duties, and the Expectations of future Rewards and Puniſhments reſulting from the true Performance or Neglect of them.

Phil. I am quite pleaſed, *Tyro*, that you have given ſuch a full and ſatisfactory an Anſwer; and I heartily wiſh you may increaſe in the Knowledge of theſe Things, and continue conſtantly in the Practice of them.

Tyr. I am obliged to you, and I hope I ſhall never live to ſee *that* Day to be a Companion with theſe Scoffers. However, if it be agreeable to you, we will at preſent paſs

paſs them by as unworthy our further Notice; and therefore, I will beg the Favour to aſk you more particularly concerning the Chriſtian Religion, as it now ſtands with the different Opinions of the various Sects and Profeſſors of Chriſtianity now among us.

Phil. I will give you an Account of every Thing as far as I can.

SECT. V.

Shewing that the Holy Scriptures teach us more of the Knowledge of God, and our Duty to each other, than any other Syſtems.

Tyr. What do you fully underſtand by the Word *Scriptures?*

Phil. The ſacred Oracles of God declared to Man, and conveyed to us by the Writings of certain inſpired Men, called *Prophets* and *Apoſtles.*

Tyr. How are the Scriptures divided?

Phil. Into two Parts, one called the *Old*, and the other the *New Teſtament.*

Tyr. What does the *Old Teſtament* chiefly ſet forth?

Phil. The *Old Teſtament* ſhews us plainly, (1.) That there is a God. (2.) That he created the Heavens and Earth, and all Things therein. 3. That he made Man after his own Image, in Righteouſneſs and true Holineſs. (4.) That Man fell from this original Righteouſneſs, which rendered him obnoxious to the divine Wrath, and drew upon himſelf and his Poſterity, Trouble, Sorrow, Sickneſs, Diſeaſes, Pain and Death. (5.) That God deſtroyed the Inhabitants of the firſt Age of the World by a Deluge of Water, eight Perſons only excepted. (6.) It tells us alſo, how God revealed himſelf to *Abraham* in the promiſed Seed, out of whoſe Loins ſhould come forth a Redeemer to loſt Man. (7.) It informs us that *Jacob* propheſied of the certain coming of this Redeemer or Meſſiah. (8.) It ſhews alſo the Laws, Statutes, and Ordinances given by God to his Servant *Moſes*, for the better regulating the Life and moral Conduct of the *Jews*, and by which were ſignified to them, under various Types and Shadows, the Truth of this Promiſe made before to *Abraham*, their Father, concerning Chriſt. (9.) Here we ſee the

binding and neceſſary Obligation of Man to God, ſummed up in the Ten Commandments given to the Children of Iſrael. The Prelude to them poſitively declares the Exiſtence of a God, from God's own Mouth—— *I am the Lord thy God.* Then he proceeds to lay before them his Will and Law, ſet forth in two Tables of Stone (comprehended in Ten Commandments) for their further Knowledge of their Creator, and the better regulating their Conduct in every moral Duty of Honour and Honeſty.

1. The *firſt* poſitively declares there is but one God.

2. The *ſecond* is a further Declaration of his Will concerning himſelf, and ſtrictly enjoins us not only to believe and adore God alone, but that we ſhould have ſuch reverend Regard for his very Name, and ſuch Thoughts of his Immenſity and Goodneſs, as not to dare to paint, carve, or form any Image, Similitude, or Likeneſs whatſoever to repreſent God, much leſs to fall down and worſhip it: For he has declared himſelf jealous, and that he will not give his Honour to another.

3. The *third* informs us, that the very Name of God is ſo ſacred, that we are never to mention it but with the higheſt Reverence, much leſs to take it in vain, in ſwearing by it, and uſing it upon every light and frivolous Occaſion.

4. The *fourth* enjoins us to a particular Obſervation of the Sabbath, (or *Sunday*) and plainly tells us, that it is God's expreſs Will that it ſhould be kept holy; and that we not only abſtain from all worldly Buſineſs, but be well employed in Prayer and Meditation all the Day long. Too true it is, that the Sabbath is become a Day of Pleaſure, and one faſhionable Sabbath-Breaker is followed or perſuaded by another, not only to neglect all Manner of Duty both public and private, but even to commit all Manner of Sin in public and in private: But if God was ſo ſevere, to cauſe a Man to be put to Death, only for gathering a few Sticks on his holy Day under the Law; what will be the Puniſhment, or what can they expect, who perpetually profane it under the Goſpel, I muſt leave to their own Reflexion and Conſideration.

5. The

5. The *fifth* Commandment is alſo the poſitive and declarative Will of God to all Children, againſt the unnatural Sin of Diſobedience: For herein God enjoins us not only to *obey* our Parents in all lawful Things, but likewiſe to *honour* and *reverence* them. And indeed the very Ties of Nature, and the natural Obligations to the Performance of this Duty, are ſuch, that (without any poſitive Command) one would hardly expect to find ſo ſhameful a Neglect of it; but more eſpecially as God himſelf has ſo cloſely enforced it, and all Nations agree concerning the indiſpenſible Duty and Obligation that every Child lies under to perform it, without Diſtinction of Age or Sex *.

6. The *ſixth* declares God's poſitive Command to abſtain from that abominable and deteſtable Sin of Murder; and under this may be eaſily perceived, that all indirect Means taken to deſtroy our own or the Health of others, either by Drinking, Debauchery, Vexations, *&c.* come in ſome Meaſure within the Limits of this Command, and are a Breach thereof.

7. The *ſeventh* Commandment tends to promote Chaſtity; Adultery, and all Uncleanneſs, being poſitively forbid by God, it being contrary to his Nature, and therefore the more *chaſte* and *ſober* we are, the nearer we approach to our Creator.

8. The *eighth* forbids very ſtrictly the Sin of Theft; that we are not to rob our Neighbour of his Property, by ſtealing from his Perſon, Houſe, or Premiſes, any Part of his Goods or Effects. It alſo binds us to abſtain from all Manner of Pilfering, all Frauds, Monopolizings, and Over-reachings.

9. The *ninth* Commandment is not only a poſitive and ſtrict Charge againſt the Sins of wilful Lying, falſe Witneſs, and corrupt Perjury, but even againſt the Sins of

* I would not have it thought that I mean here to dictate, or find Fault with the Miniſters and Brethren of the various Sects among us.—But this I may venture to ſay, that the Subject of all relative Duties has not, nor is yet enforced from the Pulpit ſo often as it ſhould be.—For I perſuade myſelf, that were they preached upon oftner, and in a proper, impartial and perſuaſive Manner, it would tend much more to the Peace and Harmony of Families, and the Honour and Glory of God, than dwelling upon controverſial Points and eternal Diſputations. See Dr. *Biſhop Patrick*, and alſo *Fleetwood*'s relative Duties,

Uncharitableneſs and Detraction. For we are herein required to abſtain from all ſly Inſinuations, and ſpeaking privately againſt our Brethren, back-biting them, and robbing them of their Character, good Name, and Reputation; and we are alſo to take Care not to give Ear to any little naſty mean Tales or Stories, that may prejudice our Neighbour, much leſs to ſpread and propagate them at Random: Therefore, if Mankind in general would but conſider the golden Rule, *of doing to others as they deſire and expect to be done by*, they would diſcourage Things of this Sort; and by ſhewing a faithful and honeſt Spirit accordingly, they never would fail to fruſtrate the Deſign of ſuch miſchievous *Deſigners*, and might prevent a great deal of Strife, which otherwiſe muſt naturally follow, when ſuch invidious deſigning Perſons are ſmiled upon, careſſed and left wholly to the Liberty of an ungoverned Tongue, by our Tacity and Connivance.

In ſhort, nothing more plainly diſcovers both a revengeful Spirit and an uncharitable Diſpoſition, than the conſtant Practice of Talebearing, and the Delight in hearing them. See *Eccleſ.* Chap. xxviii. ver. 8, 9, 10, 11, *&c.* Chap. xxi. ver. 25, 26, and 28.

10. The *tenth* and laſt Commandment not only forbids the Sin of Covetouſneſs (which is more particularly taken by ſome for graſping after Riches) but teaches us to bridle and reſtrain the inordinate Paſſion of our Deſires in luſting, longing, and wiſhing for thoſe Things which belong to others; and to take particular Care not to envy thoſe whom Providence has thought fit to place in a ſuperior Station of Life, but to be content and eaſy in that Condition, faithfully diſcharging our Duty in that State of Life unto which it has or ſhall pleaſe God to call us.

Thus ſpeaketh the moral Law given by God to the Jews, and is now binding to us as well as them, as is confirmed not only by the Apoſtles, but by Chriſt himſelf, who ſays,—*Thou ſhalt love the Lord thy God with all thy Heart, with all thy Mind, with all thy Soul, and with all thy Strength*—*And thy Neighbour as thyſelf.*——To which he further adds, ſaying—*On theſe two Commandments depend all the Law and the Prophets.*

Tyr.

Tyr. What more does the *Old Teſtament* contain?

Phil. Not only the moral Law, containing what we are commanded to do; but alſo the Example of many good and wiſe Men, whoſe Practice and Patience are Leſſons for us to copy after, and their Writings worthy our conſtant Peruſal and Attention, as witneſs the Book of *Job*, the *Pſalms* of *David*, the *Proverbs* of *Solomon*, and his Book of *Eccleſiaſtes*, all which far ſurpaſſes all the Writings and Sayings of the antient Philoſophers.

Tyr. I am of your Opinion, indeed, Sir.

Phil. I am glad of it, *Tyro*; but even theſe do not come up to the Spirit and Grandeur of many of the Prophecies, particularly thoſe of *Iſaiah* the Prophet, in which Book, are ſuch ſublime Sentences and exalted Expreſſions, that it would have been impoſſible for any Man, diveſted of ſupernatural Gifts, to have done the like, much leſs to foretell the coming of the Lord in the Fleſh, and the State of the Church, reſpecting both *Jews* and *Gentiles*, as they all have done, of which the *New Teſtament* is a ſufficient Witneſs.

2. *Of the New Teſtament.*

Tyr. What do you mean by the *New Teſtament?*

Phil. That Part of the Holy Scriptures, which were written by inſpired Men, after the Aſcenſion of our Lord Jeſus Chriſt: giving a true and conciſe Account of his Birth, Acts, Miracles, Sufferings, Death, Reſurrection, and Aſcenſion, agreeable to the Prophecies of the *Old Teſtament*, and to which they themſelves are undeniable Witneſſes, that the ſame Prophecies were true, and completely accompliſhed in him; and therefore are more particularly and emphatically called the Apoſtles of Chriſt.

Tyr. What does the *New Teſtament* principally teach us?

Phil. The chief and principal Point of all, no doubt, is this. (1.) That we ſhould firmly believe that Jeſus Chriſt is come in the Fleſh. (2.) That he led a holy and unſpotted Life, and went continually about doing Good. (3.) That he was crucified for our Sins, and offered unto God the Father a full, perfect and ſufficient Sacrifice for us. (4.) That God the Father accepted

cepted this Sacrifice and Atonement. (5.) That he roſe again the third Day from the Dead. (6.) That this is a Token or Confirmation of our Reſurrection alſo. (7.) That he aſcended into Heaven, and there maketh continual Interceſſion to God for us; and, (8.) That he will come again from Heaven to judge both the Quick and the Dead, and will render to every Man according to his Works done in the Body, whether they be Good or Evil. *Hebrews*, Chap i. Ver. 3. Chap. ii. Ver. 9, and 17. Chap. vii. ver. 25. St. *John*, Chap. v. Ver. 28, 29. 1 *Cor.* Chap. xxv. 1 *Theſſ.* Chap. 1 Ver. 7, 8, 9, 10; and many other Places.—Thus far concerns the Matter of our Faith and Belief——Next follows our Practice.

Tyr. What does the *New Teſtament* teach us concerning our Carriage, Deportment, and Oeconomy?

Phil. Every Thing conſiſtent with our Faith and Belief, not only forbidding us to abſtain from every Vice, but in every Part charges us to follow all Chriſtian Virtues, according to the Example of him, in whom we believe; and agreeable to the Practice of all his Apoſtles and true Diſciples.

Tyr. I confeſs (with Shame!) that ſince I have been grown up, I have not read ſo much of the Scriptures as I ſhould have done; and I own that one Reaſon has been, I have often heard them ſpoken of, in a very indifferent Manner, viz. that they contradict one another; were only contrived to frighten Mankind; and that no Man in his Senſes can believe ſuch marvellous, miraculous and ſupernatural Stories, as are there inſerted.

Phil. I am pleaſed with this free and candid Confeſſion.—But let me aſk you one Queſtion: You ſay, you uſed to read the Bible but ſeldom; pray tell me as frankly upon what Motive, or with what View or Deſign did you read?

Tyr. I ſuppoſe upon the ſame Motive as all deiſtical Perſons do, and that was to hunt after and pick out all the ſeeming Contradictions, which I was extremely proud to find, as I knew it would be a Feather in my Cap at our next Meeting.——However, it is not ſo now; for I own it is the beſt and moſt uſeful Book in the World.

Phil.

Phil. And ſo would many thouſands more beſides you, were they to read it often, with due Attention and Impartiality—And why ſhould they not? there is a perfect Harmony and Agreement between the *Prophets* of the *Old*, and the *Apoſtles* of the *New Teſtament*, concerning the Syſtem of our Redemption; and therefore it is a fooliſh Criticiſm, to carp at, and cavil about the hiſtorical Part only, which is not at all material to us, and quite foreign to the principal Deſign of thoſe inſpired Writers, whoſe Buſineſs was chiefly to proclaim the glad Tidings of Salvation.

Tyr. I am now very ſenſible of it, *Philomathes.*

Phil. But that which ſurprizes me moſt is, that any Man pretending to know Senſe and good Manners, ſhould think he ſhines in Wit, becauſe he is polite enough to ridicule the Scriptures.—And yet Numbers of theſe Deiſts are great Pretenders to, and great Pleaders for the Performance of all the Rules of moral Virtues. Behold, what Injuſtice and Inconſiſtency here is!—Can *Seneca* or any of the Heathen Philoſophers furniſh us with ſuch Rules of all moral Virtues, or have any of them ever expreſſed themſelves ſo beautifully concerning Prayer and Praiſes to God, and all the relative Duties of Mankind to one another in every Station and Degree of Life?—— Let them read *Moſes*'s conſtant Charge to the Children of *Iſrael*, the *Pſalms* of *David*, the incomparable Books of *Proverbs* and *Eccleſiaſtes*, in the *Old Teſtament*; then Chriſt's Sermon on the Mount, the Epiſtles of St. *Paul*, St. *John* the Divine, and St. *James* in particular, in the *New Teſtament*; and then let them ſee whether all Manner of Vice is not forbidden, the bad End it tends to evidently pointed out, and every ſocial and Chriſtian Virtue highly promoted.—— Nothing is herein wanting or defective.——Here is ſet forth evidently the Duty of *Kings**, *Subjects*, *Huſbands*, *Wives*, *Parents*, *Children*, *Maſters*, *Servants*, and of all Mankind one towards another, in all their different Sta-

* Though I have here mentioned Kings before Subjects, in Order, yet the relative Duties and Obedience begin with the Inferiors; that is, with the Subjects, Wives, Children, and Servants; then follow the Duties of the Superiors in return, which are equally obligatory.

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tions of Superiority and Subordination.—The Holy Scriptures teach us the following Virtues, viz. *Affability*, *Amity*, *Beneficence*, *Benevolence*, *Brotherly-Love*, *Charity*, *Chaſtity*, *Comity*, *Equity*, *Fidelity*, *Friendſhip*, *Fortitude*, *Honeſty*, *Honour*, *Hoſpitality*, *Humility*, *Humanity*, *Juſtice*, *Liberality*, *Loving-kindneſs*, *Longanimity*, *Manſuetude*, *Mercy*, *Modeſty*, *Prudence*, *Sincerity*, *Sobriety* and *Temperance*.—— Can the Enemies of theſe ſacred Writings ſay the contrary?——Go then, thou partial *Deiſt*, thou Pretender to the Love and Practice of Morality—go forthwith and learn Leſſons out of that Book, which thou haſt ſo long deſpiſed, that thou mayeſt eſcape the Judgment which it pronounceth againſt all obſtinate and unrepenting Scoffers of God's Word.

Tyr. What you have ſaid in the Praiſe of the *Old* and *New Teſtament* is very true; and I am ſenſible, that the Reaſon why ſo many ſpeak againſt them, is chiefly owing to what they hear others ſay, and never ſeeking any farther; but would they but be reſolved to read them often, and with a Spirit deſiring to be improved, I might venture to ſay of them, as an eminent Author ſays in Praiſe of *Milton*'s *Paradiſe Loſt*; "The oftner we read "it, the more Beauties we diſcover."

Phil. You are very right.

Tyr. Thus far, then, dear *Philomathes*, you and I agree; and now I ſhould like you would give me ſome Account of the Riſe and Progreſs of Chriſtianity, and the different Tenets and Principles of the various Sects now among us.

Phil. You require too much to be here performed; however, I will do all I can.

SECT. VI.

Of Judaiſm, Paganiſm, Chriſtianity, and Mahometaniſm.

Tyr. What do you mean by *Judaiſm?*

Phil. 1. The Cuſtom, Religion, Manners, and Profeſſion of the *Jews*, according to the Ceremonies of the Law only.—They were firſt called *Hebrews*, from *Heber*, the Father of *Abraham*; and *Iſraelites* from *Jacob*, whom God called or named *Iſrael*; and afterwards they were called *Jews* from *Judah*, *Jacob*'s fourth Son. So alſo

alſo the Land of *Iſrael*, the Land of *Judah*, or *Judea*, are the ſame Thing.

2. The Hiſtory of the *Jews*, their Riſe and Bondage, their great Deliverance from it, the Law of God given to them, their Ceremonies and Manner of Worſhip, you have at large in the *Pentateuch*, or the five Books of *Moſes*, called *Geneſis*, *Exodus*, *Leviticus*, *Numbers*, and *Deuteronomy*. Here may be ſeen, their perpetual Deliverance from ſtrange and powerful Nations, and at the ſame Time their perpetual Ingratitude, Unthankfulneſs, and Murmurings, not only againſt *Moſes*, but even againſt God himſelf; till the Lord was ſo provoked with them, as to deſtroy at one Time above 14,000 (*Numb.* Chap. xvi), and at another Time of a Plague 24,000 (Chap. xxv), with many other Inſtances of his Judgments; and notwithſtanding this, they kept continually murmuring againſt the Lord and his Servant *Moſes*, provoking him to ſpeak raſhly and unadviſedly with his Lips; ſo that at laſt, God told him, neither he nor they ſhould ever poſſeſs the promiſed Land of *Canaan*; and accordingly *Moſes* died on Mount *Horeb*, and their rebellious Carcaſſes fell in the Wilderneſs.

3. It alſo evidently appears, that *Moſes* foreſaw that this continual and ſtubborn Behaviour would certainly end in their final Deſtruction, without a Reformation of their Manners and Conduct; and therefore, it is worthy our Obſervation to ſee the Love he bare to them, notwithſtanding their Ingratitude. For before his Death he expreſſed himſelf to them in ſuch a pathetic Manner, and gave them ſuch fine Leſſons in every Part of their Duty, to be performed both to God and each other, that perhaps cannot be paralleled for Love, Beauty, and Eloquence. See *Deut.* Chapters iv. v. vi. vii. viii. ix. and xxxii.

4. After the Death of *Moſes*, *Joſhua* became their Head and Leader, and he conducted them over the River *Jordan*, fighting all their Battles, in which he was victorious over all the Nations that oppoſed him, till he brought them into the Land of *Canaan*, according to God's Promiſe.

5. After the Death of *Joſhua* they had no particular Leader or Guide, but every Man did that which was right

right in his own Eyes, running after the Gods of the Heathens making to themſelves *Teraphims* or Houſhold Images, forſaking the Covenant of the Lord their God, going to every Mount and Valley, and under every green Tree, to worſhip the falſe Gods of the *Egyptians*, the *Ammonites*, the *Moabites*, the *Philiſtines*, the *Zidonians*, &c. and not only this, but they got to ſuch a Pitch of abominable Wickedneſs, as even to make their Children paſs through the Fire; and even offered their Sons and Daughters to Devils. *Judges*, Chap. xvi. and xvii. *Numb.* xxi. and xxii. 2 *Kings* xvii. *Ezek.* viii. 1 *Kings* xi. read alſo the Books of the Prophets *Iſaiah*, *Jeremiah*, *Ezekiel*, &c.

6. The Government or State of the *Jews* has undergone various Changes, *viz.* (1.) It was *patriarchal*, when the Fathers of every Family were Kings and Prieſts in their own Houſes; and after their Deceaſe the Firſt-born had the ſame Power, to take in, caſt out, give, or diſinherit, bleſs, curſe, and puniſh with Death, *&c.* (2.) After this it was *dictatorial*, under the Power and Command of *Moſes* and *Joſhua*. (3.) It afterwards became *ariſtocratical* in the Time of the Judges, and alſo the Intervals between the Death of one Judge and the chooſing of another, for then they were ruled and judged by the *Sanhedrim*, *viz.* by the Authority of the great Court of the ſeventy Elders. (4.) After this it was *monarchical* under *Saul*, their firſt King, and ſo continued in *Judah* till their Captivity, which was about 520 Years. (5.) In the Time of their Captivity they were under various Changes of Government, from *Zerubbabel* to *John Hircanus*. (6.) They again became a *monarchical* and regal State, under twelve different Kings.

7. The *Jews* acknowledge the written Law of *Moſes*, comprehending the Ten Commandments, *&c.* but they prefer the *Oral* Law much before it; for they ſay *this* is the Explanation or true Annotation of the written Law; and that it was given to *Moſes* in the *Mount*, at the ſame Time the written Law was given; that he communicated it to *Joſhua*; *Joſhua* to the ſeventy Elders; theſe gave it to the Prophets; from thence it came into the great Synagogue; and there by the wiſeſt *Rabbies* it

was

was digeſted into Order; and, when finiſhed, was called the *Talmud*, or Holy Book, being, they ſay, the very Foundation of the written Law of *Moſes*, as that is very ſcanty and deficient, and the *Talmud* explains all the doubtful Paſſages, and is ſo fine a Supplement, that nothing is to be compared to the moſt holy *Talmud*.

8. The Ceremonies and Worſhip of the *Jews* are ſo many and ſo different, it would be impoſſible to ſpeak of them in their Place; but concerning their Opinions, thus much may be ſaid, That they believe in one God only, the Creator of Heaven and Earth: That he is ſelf-exiſtent, immortal, abſolute, and irreſiſtible: That he alone is to be worſhipped, and that without a Mediator: That he knows and governs all our Actions: That *Moſes* was the greateſt Prophet of all others: That the Law which was given to him is of divine Authority, and delivered by divine Inſpiration: That all its Precepts are immutable, and that we are to do what this Law commands, and avoid what it forbids: That the Meſſiah will come at the End of Time, and the Dead ſhall be raiſed, and every Man be judged according to his Works.

9. The *Jews* did always, and do ſtill obſerve and keep certain Feaſts or Feſtivals, *viz.* (1.) Their Sabbath. (2.) The Paſſover, or Feaſt of unleavened Bread, kept at *Eaſter*. (3.) Their Pentecoſt, kept at *Whitſuntide*. (4.) The Feaſt of Tabernacles, kept for ſeven Days, during which Time they uſed to live in Booths, *&c.* (5.) The Feaſt of Trumpets. (6.) The Feaſt of Atonement or Expiation. (7.) The Feaſt of new Moons, being the firſt Day of their Months. (8.) The ſabbatical Year, or Year of Reſt, being every ſeventh Year, in which they neither tilled the Ground, ſowed or reaped; this was in Commemoration of the Sabbath itſelf. (9.) The Feaſt of Dedication. (10.) The *Purim*, or Feaſt of caſting Lots. (11.) The Year of Jubilee, called the Sabbath of ſabbatical Years, or every *fiftieth* Year, at which Time or Feaſt all Places or Eſtates returned to thoſe who ſold them, and all Slaves were ſet at perfect Liberty, *&c.*

10. The Orders of Men among them were, (1.) The High-Prieſt, of which *Aaron* was the firſt, and his Firſt-

born

born after him in lineal Deſcent. This firſt High-Prieſt, *Aaron*, was undoubtedly a lively Image or Type of our High-Prieſt the Son of the living God. *Hebr.* Chap. iii. and v. (2.) The common Prieſthood, which belonged particularly to the Sons of *Levi*. (3.) The *Nethenims*, (which were no *Jews*, but *Gibeonites*, *Joſ.* ix.) who were Hewers of Wood, and Drawers or Procurers of Water, and were Singers in the Service of the Temple. (4.) Elders or Miniſters of the Synagogue, ſome of which were called, (5.) *Sheliach Zibbor*, or the Meſſenger or Angel of the Church. (6.) The *Cheſanims*, or Overſeers, who had the Charge of the Synagogue, and kept the Book of the Law, and *Liturgies*, and all the Utenſils. (7.) The *Chazan*, who ſtood by to overlook and direct thoſe who read the Law and the Prophets. (8.) The Interpreter, whoſe Province was to render the Leſſons which were read to the People in *Hebrew* into the *Chaldea* Language, the common People having quite forgot the *Hebrew* Tongue in the Time of their Captivity. (9.) The *Text* itſelf, or Portion read or taken out of the Law of *Moſes*, the *Jews* call *Torah*, and the *Explanation* or *Paraphraſe* upon it, they call the *Targum*.

Of the SECTS *of the* JEWS, *&c.*

1. The *Phariſees*, who were the moſt noted Sect among the *Jews*, and in reſpect of which the others were called *Diſſenters*: They profeſſed or received the written Canon of the Scripture, and held all Manner of Traditions, and Superſtitions of their own Invention: They are particularly pointed out for their Pride in chooſing the chief Seats at all public Aſſemblies, were remarkable for their going about making long Prayers, to be ſeen of Men, and to be eſteemed in the Eye of the Public more religious than their Neighbours, always watching other People's Actions, and finding Fault with every Trifle, ſtraining at Gnats and ſwallowing Camels.

2. *Scribes*; theſe were of two Sorts, the one taught, tranſcribed, and interpreted the Law and the Prophets in the Schools; the other belonged to or profeſſed the Civil Law, and were called *Lawyers*.

3. The

3. The *Sadducees* were a Sect among the *Jews*, that with the *Phariſees* believed the written Law, and the Doctrines of the Reſurrection, Angels, and Spirits; but at laſt fell away from this, and embraced and maintained many falſe and impious Principles, denying the Reſurrection of the Dead, and the Being of Angels and Spirits; they were the very Riſe of the *Epicureans*, and our modern *Deiſts* are greatly indebted to them, for their early Precedent and Example, in denying ſupernatural Power, and oppoſing every Thing that has not ocular Demonſtration.

4. The *Samaritans* were a Sect of mongrel *Jews* or Heathens; ſome however conformed to the *Moſaic* Law but rejected all other Traditions, and ſaid that God ought to be worſhipped on Mount *Gerizim*, and not at *Jeruſalem*. You read in St. *John*, Chap. iv. that the *Jews* hated them ſo much, that they had no Dealings or Connection with them.

5. There was another Sect, but not of much Note, called *Karrites*; theſe were ſuch *Jews* as abided wholly by the written Law of *Moſes*, rejecting the *Oral* Law, and many other Traditions and Superſtitions of the *Jews*. There are many of this Sort among the *Jews* to this Day.

6. *Herodians*, or the Admirers and Followers of *Herod* the Great, whom they honoured with ridiculous Solemnities and Orations, believing him to be the Meſſiah, at other Times extolled him ſo as to call him God. See *Matth.* Chap. xiv. *Luke*, Chap. xiii. *Acts*, Chap. xii.

7. *Publicans*; theſe were only Officers, who collected Tribute, or gathered in the Taxes impoſed by the *Roman* Emperors upon the *Jews*, who never could eaſily ſubmit to ſuch Taxations, therefore hated both the Impoſer and the Collectors of ſuch Taxes.

8. Another Set of Officers were called *Maſorites*; they examined all the Bible throughout very ſtrictly, and then put the Meaning of the Text, or difficult Words, into the Margin, (which they call the *Kert*) right againſt the difficult or wrong Word, which they called *Celib*.

Thus

Thus much, *Tyro*, for a general Hint of the *Jewiſh* Religion, Rites, *&c.* but for the general and particular Hiſtory of their Wars, Tranſactions, and Viciſſitudes of their State, from Time to Time, read *Joſephus*'s Hiſtory of the *Jews*.

Tyr. I am highly obliged to you, *Philomathes*.

SECT. VII.

Of PAGANISM.

Tyr. What is *Paganiſm*.

Phil. The Religion of the *Heathens*, or their Adoration and Worſhip of Idols and falſe Gods.

Tyr. How and what were the Gods they worſhipped?

Phil. Not only Gods in the ſuppoſed Form of Men, ſuch as *Jupiter*, *Mars*, *Bacchus*, *Apollo*, *Venus*, *Diana*, &c. but even Birds, Beaſts, Fiſhes, creeping Things, as alſo Trees, Plants, and Vegetables.

Tyr. Pray give me an Account of theſe Heathen Deities, their Pedigree, Titles, *&c.*

Phil. I will, as far as Time and Room will allow of, but this I chooſe rather to do under the Head of *Mythology*, which I ſhall very conciſely treat of hereafter; therefore we ſhall at preſent touch upon *Mahometaniſm*.

SECT. VIII.

Of MAHOMETANISM.

Tyr. What is *Mahometaniſm?*

Phil. The Profeſſion and Practice of the Religion or Tenets of *Mahomet*.

Tyr. What are thoſe?

Phil. (1.) That there is but one God, and he ought to be worſhipped. (2.) That the ſame God raiſed up various Prophets in the World, and that we ought to eſteem them as his Meſſengers, and obey them. (3.) That *Mahomet* himſelf was one of the Head of theſe Prophets. (4.) They believe in Angels and Spirits, the Reſurrection and Day of Judgment. (5.) They hold with the Duties of Prayer, Faſting, Alms-giving, *&c.*

Tyr. Who, and what was *Mahomet?*

Phil. (1.) *Mahomet* was Son of *Abdollah*, of the Tribe of the *Karaiſhes*, his Mother's Name *Amena:* He was born

born at *Mecca*, a City of *Arabia*, *A. D.* 571. (2.) His Father dying while he was young, he left him to the Care of his Uncle *Abu Taleb*, a conſiderable Merchant, and he uſed to go with Camels trading to *Syria*. (3.) *Mahomet*, it is ſaid, lived with his Uncle till he was about 25 Years old, at which Time one of his Uncle's Acquaintance, a great Merchant in *Mecca*, died, and left his Effects to *Cadigha*, his Wife, who invited *Mahomet* to tranſact his Buſineſs, which he did, and in three Years after married her, he being then about 28 Years of Age. (4.) *Mahomet*, trading largely to *Egypt*, *Paleſtine* and *Syria*, knew well the Opinion both of the *Jews* and *Chriſtians*, and their different Sentiments of Religion; and therefore being well known, and having ſome perſuaſive Powers over both, he bethought himſelf, that the beſt Way to be admired would be to frame, compoſe, and broach ſome new Syſtem of Religion, ſuitable to both Parties, which drew in Numbers of every Sect and Perſuaſion. (5.) In order to this, he, by Degrees, not only grew very ſtrenuous of all Manner of ſuperfluous Eating and Drinking as uſual before Men, but every Morning withdrew into ſome ſolitary Place or Cave, and there (as is reported) ſpent his Time in Abſtinence, Faſting and Prayer; but others ſay, he reſorted to theſe private Places, with divers Prieſts and Monks, and conſulted with them concerning this new Scheme of Impoſture. Thoſe that approved of it, he careſſed, and ſuch as did not he diſcarded, and being now a Man of great Power, his Ambition raiſed him to the Pitch of Sovereignty; ſo that at laſt, whatever *Mahomet* was pleaſed to ſpeak of, preach, or publiſh, few or none dared gainſay or contradict. (6.) Having laid his Plan ſo well, the next Thing was to make Converts to his new Syſtem of Impoſture; and therefore begins with his Wife, *Cadigha*, telling her how the Lord had appeared to him in different Places and Times, both by Dreams, Viſions, and Voice, and had called him to be a *Prophet* among the People; but ſhe was not eaſily perſuaded into ſuch Stories, and told him ſhe believed they were only Fancies and Deluſions of his own; but *Mahomet* willing to convert his Wife rather by Perſuaſion than Force, took into his Houſe a fugitive

fugitive Monk, Prieſt or Frier, (whoſe Name is ſuppoſed to be *Zal Abu*, or *Abu Taleb*) and he confirms to her all that *Mahomet* had told her, with the Addition of his having ſeveral Times converſed with the Angel *Gabriel*, and that he had himſelf heard ſtrange and terrible Voices talking with him in Caves and different Places: By this Atteſtation and other Schemes of Impoſture, contrived by *Mahomet*, and his impious cringing Votaries, they at laſt brought over *Cadigha* to believe every Thing that was ſaid concerning the Miſſion of her Huſband, whom ſhe at laſt confeſſed and believed to be a Prophet indeed. (7.) Having by Stratagem made his Wife a ſtrong and powerful Proſelyte, he ſoon made his whole Houſhold ſo; prevailing upon his Servants and Slaves to adhere cloſely to his Doctrine, by a Promiſe of their Freedom: They accordingly accepted it; and he made a Law, which remains to this Day, that all Slaves embracing his Religion or Tenets ſhall be made free. (8.) Now *Mahomet* acts more openly, and getting ſome Principals of the City of *Mecca*, he publickly declares himſelf a Prophet, ſent from God to convert them from Paganiſm to his true Religion. (9.) He was never wanting to aſſert the conſtant Attendance and Preſence of the Angel *Gabriel*, and as poſitively aſſerted that God had raiſed him up to correct the Errors of all other Prophets, and had revealed his Will and Deſign to him of every Thing he intended ſhould be done hereafter for the Advantage of his Church on Earth. (10.) *Mahomet*, in order to confirm the Truth of all he ſaid, and jealous of its not being believed by the People in general, proceeds yet further, and ſays, that God himſelf, by the Angel *Gabriel*, gave him an Invitation to his holy Habitation, and accordingly he went. (11.) *Mahomet* alſo acted ſtrongly upon the Paſſions of his Followers, by his deſcribing Heaven and Hell as a future Reward of Virtue and Vice: For, as he lived in the Torrid Zone, (where there is no Want of Heat) he accordingly tells thoſe Converts that embraced his Doctrine, that they ſhould certainly go to Heaven, and there enjoy Pleaſures far beyond Conception, *viz.* Women, ever young, beautiful, and obliging; ſhady Walks, ever green, cool, and pleaſant; delightful

delightful Rivers and Streams; delicious Fruits of all Sorts, and an eternal, uninterrupted Enjoyment of all Manner of Dainties and Delicacies: But to all ſuch as held him or his Doctrine in Contempt, he pronounced their infallible Condemnation to Hell itſelf, which he painted out to their Senſes in very terrible Shapes; telling them, it was a Place where there was nothing but a hot and ſcorching Air, and black Smoke; their continual Eating would be Briars, Thorns, Cinders, Aſhes, and burning Pitch, and their Drink, boiling hot Water, melted Lead, *&c.* (12.) *Mahomet*, however, was oppoſed by many, and being required to work Miracles, or ſhew ſome Signs of his Miſſion, that they might believe, he told them, that God was angry with them for their Diſbelief, and therefore would not ſhew any more Signs and Wonders among them. (13.) *Mahomet* however was reſolved to be even with his Oppoſers, for he got an Army together, and went to *Medina*, and ſlew all that did not own him as God's great Prophet; telling them at the ſame Time, that as God had ſent *Moſes*, *Jeſus*, and other Prophets, who did Miracles, and they would not believe; he had now ſent *him* to chaſtiſe them with the Sword for their Infidelity. (14.) *Mahomet* nevertheleſs knew that the working of Miracles would certainly gain him more Reſpect, and therefore, as he knew he had no Power to work any, he cunningly gets a Set of Men to atteſt they ſaw him do many, *viz.* that pure Water ſtreamed from between his Fingers; that the Trees went forth to meet him and follow him; that he once clave the Moon in ſunder, and put it together again; that a Shoulder of Mutton once ſpoke to him; with many more ridiculous Stories, by which *Mahomet* loſt the Favour of thoſe, who had any Senſe to think at all, and became an Impoſtor in the Eye of the moſt ſenſible Part, both of *Jews*, *Pagans*, and *Chriſtians*.

Tyr. How could he expect any other? Could he imagine ſuch Nonſenſe as this ſhould be received without Thought and Conſideration? However, if you have any Thing further to ſay of his Pranks, let us have them, for they are diverting enough.

Phil. There is nothing but only his being invited to Heaven; his Converſe with God there, and ſome other ridiculous and blaſphemous Things, I think hardly worth your Notice.

Tyr. Pray now, my dear *Philomathes*, give me a little Account of *that*, for I am ſure it will divert me more and more.

Phil. Obſerve then:

2. *Of* Mahomet's *Meſra, or Night-Journey to Heaven*, &c.

Mahomet not being yet able to make all the People Proſelytes, contrives another Scheme, which was to retire one Night from his own Houſe in a very private Manner, and returned the next Morning; during which Time he was carried to Heaven, had Converſe with God himſelf, and brings back Inſtructions how to rule the People.——The Story is as follows. (1.) *Mahomet* (about twelve Years after his pretended Miſſion) being in bed, heard, at the dead Time of the Night, an uncommon Knocking at his Door, (which was contrived by him and his Cabinet Friends) and ſtarting up ſuddenly, he tells his Wife, that he knew he had a ſpecial Meſſage from God, and therefore haſtened down with all Speed, and there found the Angel *Gabriel*, who took him by the Hand, and with a pleaſant Countenance told him, that he was ſent to conduct him to Heaven, as being a Favourite of God, and that he would there ſee Things, and learn Myſteries paſt Man's Underſtanding. *Gabriel* had ſeventy Pair of large expanded Wings, and brought with him *Alborak*, or the white and holy Mule for *Mahomet* to ride on. (2.) *Gabriel* bids him mount with Speed; but as *Alborak* had not carried any Prophet to Heaven ſince Chriſt, he was now grown idle and ſkittiſh, and would not ſuffer *Mahomet* to mount him, till he promiſed the Beaſt to get him a Place of Eaſe and Reſt in Paradiſe. (3.) *Mahomet* by this mounts quietly, and *Gabriel* taking hold of the Bridle, they arrived at *Jeruſalem* in an Inſtant of Time. (4.) *Mahomet* proceeds to the Temple, at the Gates of which he was met by *Moſes* and all the departed Prophets, who hailed him, and accompanied him with Joy into

into the Temple, where they had ſome Converſation upon his Miſſion and Journey; and before their parting they all deſired his particular Prayers for them, and modeſtly left him. (5.) *Mahomet* now returning out of the Temple, found a Ladder of Light fixt from the Earth to the firſt Heaven. *Gabriel* and he aſcend it, having firſt tied [poor] *Alborak* to a Rock, till he returned. (6.) They ſoon arrived at the firſt Heaven, which was pure Silver, where he ſaw *Adam*, who, after thanking God for ſo great and good a Son, he deſired *Mahomet* to remember him in his Prayers. Here he ſaw alſo Angels, Men and Beaſts, in all Shapes; but particularly a Cock, whoſe Head reached from the firſt to the ſecond Heaven, though the Diſtance was ſo great that it will take (he ſays) 500 Years to arrive there. This Cock is decked with Pearls, and God ſings or ſpeaks to it every Morning, and then it crows and ſets all the Cocks in Heaven and Earth a crowing alſo. (7.) From hence they aſcended to the 2d, 3d, 4th, 5th, 6th, and 7th Heaven. In the 2d Heaven he ſaw *Noah*, in the 3d *Abraham*, in the 4th *John*, in the 5th *Moſes*, in the 6th *John the Baptiſt*, with whom he had much Talk, and they all recommended themſelves to his Prayers. He alſo ſaw in the 3d Heaven the Angel of Death, the Diſtance between whoſe Eyes would take a Journey of 200 Years; who takes an Account of all Perſons that ever were born, and when they die he ſtrikes their Names out of the Book. (8.) *Mahomet* now comes to the 7th Heaven, and here he ſaw Jeſus, and after ſome Talk deſires that Jeſus would pray for him. Paſſing on further he ſaw an innumerable Company, one of which he could not help remarking, he having ſeventy thouſand Heads, and in every Head ſeventy thouſand Tongues, and every Tongue utters ſeventy thouſand diſtinct Voices at once, praiſing God Night and Day. (9.) *Mahomet* being now at the 7th Heaven, *Gabriel* now tells him he muſt leave him, but gave him Directions which Way to proceed to the Throne of God; and after paſſing through Snow, many Floods of mighty Waters, and other great Difficulties, he at laſt heard a great but gracious Voice, ſaying, *O* Mahomet, *beloved of God, ſalute thy Creator.*——Then he

came to a Place which far exceeded the Sun for Light and Brightneſs:——Here he ſaw the Throne of God, which ſurpaſſes all Thought or Deſcription; on the right Side of which was written in *Arabic*, theſe Words, LA ELLA ELLALLAH, MOHAMED RESUL OLLAH, which is, *There is no God but God, and Mahomet his Prophet.* (10.) *Mahomet* then drawing nearer, ſaw God ſitting on his Throne; but did not ſee his Face, becauſe he had ſeventy thouſand Veils over it; but he ſays, God laid his Hand upon him, as a Mark of his Favour towards him, but it was ſo extremely cold that it ſtruck through the very Marrow of his Backbone: But God very tenderly withdrew it, and familiarly entered into Converſation with him; communicating to him the hidden Myſteries of the Law, and inveſted him with a Power above any other, and laid a particular Charge upon him to communicate the ſame to all Mankind upon his Return. (11.) *Mahomet* being diſmiſſed from the Preſence of God, returns to *Gabriel*, who conducted him back again to *Jeruſalem*, where, mounting the white Mule *Alborak*, he returned to *Mecca* the ſame Night he ſat out upon this Journey.

Tyr. A ſurprizing Relation indeed! But how is it poſſible for any Man in his Senſes to believe any Part of it, ſince *Mahomet* himſelf has acknowledged, that the Journey he performed in an Hour and a Half would take above four thouſand Years to complete.

Phil. He has ſo; and this ſhews *Mahomet*'s Judgment in *Aſtronomy* and *Religion* were much alike; for it is evident that at the Rate of forty Miles a Day, it would take up five thouſand five hundred Years to arrive at the Diſtance of the *Sun* only, whoſe Diſtance bears but little Proportion to the Diſtance of ſome Stars, or the empyreal Heaven; and therefore conſequently falls ſo infinitely ſhort of the Diſtance of the higheſt Heaven, that it will bear no Compariſon at all.

Tyr. Very true; but pray how did *Mahomet* manage Affairs after his Return?

Phil. You muſt naturally conclude, that ſome believed what he aſſerted, and others would nor could not; therefore it cauſed Contentions and Inſurrections; and the principal Men of *Mecca* were reſolved to examine him

him more cloſely upon it, and puniſh him accordingly; but he having timely Notice, fled ſecretly with his Party to *Medina*, a large City in *Arabia*; there he propagated his new Syſtem, built a Place for the Exerciſe of his new-fangled Religion, and iſſued out Orders that all Computation of Time ſhould begin the Day of his Flight, called *Hegira:* From hence commences the *Mahometan Æra*, which was on *July* the 16th, in the Year of Chriſt 622.

Tyr. I am obliged to you, *Philomathes*; and how did he proceed in *Medina?*

Phil. The ſame as in *Mecca*, always creating freſh Diſturbances, by propagating Lies and Impoſtures; but the People in general not believing his blaſphemous Tales, nor embracing his ridiculous Tenets, he (like the Church of *Rome)* takes up the Sword of Chaſtiſement, ſtrictly forbidding all his Soldiers or Diſciples to diſpute or parly with the Chriſtians, or any other Sect, concerning the Authority of his Miſſion or Religion, but to cut off all that dare to oppoſe it, and that would not immediately promiſe to embrace it. Thus he went on till the ſeventh Year of his *Hegira* or Flight from *Mecca*, and now proceeds to *Chaibar* in *Arabia*, and was entertained by one *Horeſh*, whoſe Daughter's Name was *Zamath*, and ſhe being no Friend to *Mahomet*, was reſolved to try whether he was indeed a Prophet or not; and therefore poiſoned a Shoulder of Mutton, which he and his Friends were to partake of one Night at her Father's, and though ſhe was deſired to deſiſt from ſo raſh an Undertaking, ſhe ſaid ſhe could not, for that her Conſcience was very eaſy in the Deſign, as her Heart had continually told her, that ſhe would certainly do God and Mankind great Service, in cutting off ſuch a Tyrant and Impoſtor. She accordingly did it, and they had not eaten long before *Baſher*, one of his great Friends, fell down dead; but the Shoulder of Mutton told the Prophet what was done to it, upon which he ſpat out what he then had in his Mouth; however, he had eaten enough to anſwer *Zamath*'s Deſign, for from that Time he lingered, pined, and waſted away, and died on his Birth-day in the City of *Medina* (being, according to their Account, juſt 63, and by ours 61

Years of Age) where he was buried, and not ſuſpended in the Air by Means of large Load Stones, as is commonly reported.

Tyr. And what did his Followers do after his Death?

Phil. Mahomet left behind him a Book which he compiled, called the *Alcoran*, or rather *Coran*, containing Rules for their Faith and Practice. This Book is held with ſuch Reverence, that whoever touches it with unwaſhed Hands is put to Death. It contains nothing but a Series of Hodge Podge, and Inconſiſtencies; ſuch as the Chapter of the *Elephant*, another of the *Cow*, the *Fly*, *&c. &c.* The Reaſon (it is ſaid) that the *Mahometans* hold this Book in ſuch Veneration is, becauſe *Mahomet* told them it was wrote with the Finger of God, upon exceeding fine Parchment, made of the Skin of the very Ram which *Abraham* offered up for a burnt Offering inſtead of *Iſaac* his Son, and God ſent it from Heaven to him in a Roll, ſealed up by the Hand of the Angel *Gabriel*.

Thus much, *Tyro*, concerning *Mahometaniſm*, which to this Day is profeſſed in *Turkey*, and ſeveral other Places in the Eaſt.

Tyr. I am very much obliged to you, *Philomathes*, for this Information: And now pray give me Leave to remind you of your former Promiſe of giving me a more particular Account of *Chriſtianity*, and the different Opinions of thoſe that profeſs it.

Phil. I will.

SECT. IX.

Of Chriſtianity, with a conciſe Account of the different Opinions, Ceremonies, and Manner of Worſhip, of the various Profeſſors of it.

1. Of CHRISTIANITY.

Tyr. What do you mean by the Word *Chriſtianity?*

Phil. (1.) *Chriſtianity*, in the general Senſe, or common Acceptation of the Word, ſignifies a true Belief in Chriſt and his Doctrine, in Oppoſition to *Idolatry* and *Paganiſm*. But, (2.) it more ſtrictly implies, not only a bare Belief in Chriſt, but a conſtant Perſeverance in all good Works; and an Abhorrence of, and abſtaining

ing from every Thing that is evil, according to the Doctrine and Examples, which both He himſelf and his Apoſtles taught and practiſed, and which are ſo evidently ſet forth to us in the holy Scriptures.—He who does this is a Chriſtian indeed, without paying any Regard to the Doctrines and Ceremonies of any particular national Church, Sect, or People; the Manner of Worſhip being only the Mode of Religion, but not Religion itſelf: For all Chriſtians, of all Perſuaſions whatever, acknowledge there is but one Way of worſhiping God—that is, *in Spirit and in Truth.* See St. *John*, Chap. iv. ver. 24.

Tyr. It is very true, *Philomathes*; and as every national Church has its different Way of Worſhip, and every Sect among us different Notions of *Theology*, how can I, that am but young, or how can thoſe that are quite ignorant know, when they are right or wrong?

Phil. Very eaſily; and that is by a conſtant Reading and Peruſal of the ſacred Books of the *Old* and *New Teſtament.*

Tyr. But you know, Sir, that they are not ſo eaſy to be underſtood by People in general.

Phil. I grant they are not; but this is no Proof that they might not be better underſtood than they are, if they were read more conſtantly and with due Attention.—But alas, *Tyro*, we never want a Plea for any Thing.—(1.) Aſk yourſelf and your Acquaintance, who plead this Ignorance of the ſacred Writings, whether you or they have read them ſo often as you ought to do? (2.) How is it poſſible to become acquainted with the Knowledge of any Art or Science, without either converſing with Perſons that underſtand it, or attentively reading ſuch Authors as have treated upon it? (3.) The greateſt Reaſon then that the Scriptures are underſtood no better, is, becauſe they are neglected ſo much. (4.) This is evident, for you ſhall meet with Men that are tolerable good Scholars, and profeſs themſelves Members of the Church, who are totally ignorant, not only of the Senſe and Meaning of a plain Text of Scripture, but they are almoſt totally ignorant there is any ſuch Text or Sentence at all. (5.) If you tell them, you are ſurprized they don't remember

ſuch and ſuch remarkable Paſſages, they immediately anſwer, that they have no Memory to retain Things like other Perſons.—Behold, what a ſeemingly modeſt Anſwer here is, to cover or excuſe the Act of a wilful Neglect, ſince the very ſame Perſons who own their Deficiency in this reſpect, would take it as a great Affront and Inſult, if any one ſhould dare to call in Queſtion their Knowledge, Memory, or Capacity in comprehending and retaining Things in general. (6.) It is evident then, that it is not ſo much the Want of Capacity or Opportunity, as the Want of Reſolution and Delight. Whoever is reſolved to read the Scriptures with theſe two Accompliſhments, I dare venture to aver, they will ſoon underſtand all thoſe neceſſary Parts that are proper and ſufficient for the Inſtruction, Duty, and Practice of a Chriſtian in every State of Life; and not only this, but would very ſoon *be ready* (or capable) *to give an Anſwer to every Man that aſketh them of the Reaſon of their Faith.* St. *Peter*, Chap. iii. ver. 15. (7.) In ſhort, were there an Embargo laid upon the Word of God in *Great Britain* as there is in the Church of *Rome*, we might then have a juſt Plea, but our Situation, you know, is quite different from theirs: For there is no Doubt but many of them would be very glad to read it oftener, but dare not; but every Sect among us, may not only read it when, and whereſoever they pleaſe, but are even preſſed upon and invited to read it oftener, yet will not. Behold what a ſtrange Abuſe of Liberty is here! What a grievous Neglect of Duty is this: To let ſlip all Opportunities of reading and peruſing ſuch Things as would enable us, not only to ſtand Proof againſt all the Adverſaries and Oppoſers of revealed Religion; but would furniſh our Minds with ſuch Knowledge which would give us unknown Satisfaction, and turn out much more to our Advantage than we are at preſent aware of.

2. *Of the different Tenets of the principal Sects, or Profeſſors of Chriſtianity.*

Tyr. I ſhould be obliged to you, *Philomathes*, to give me a ſhort Account of the Tenets of the various Profeſſors of the Chriſtian Religion.

Phil.

Phil. That would be almoſt impoſſible; therefore, you muſt be content if I tell you no more than the Tenets, Articles of Faith, and Manner of Worſhip of the Profeſſors of the three principal Churches in *Europe*, viz. the Church of *Rome*, the Church of *England*, and the Diſſenters.

1. *Of the Church of* Rome.

Tyr. What do you mean by *Roman Catholicks*, or Papiſts?

Phil. The Followers or Profeſſors of the Doctrine of the *Romiſh* Church, or Papiſtry.

Tyr. What are the principal Tenets of the Church of *Rome?*

Phil. They ſay or believe, (1.) That *Jeſus Chriſt* is one of the Perſons in the moſt Holy Trinity. (2.) That he came from Heaven, took our Nature upon him, and ſuffered Death upon the Croſs. (4.) That before he aſcended to Heaven, he inveſted the Apoſtle *Peter* with the Power of Infallibility. (5.) That he gave him the Keys of Heaven and Hell, with a full Power of remitting or retaining the Sins of Men. (6.) That in the Year of Chriſt 42, the Apoſtle Peter went to Rome, and governed the Church there as ſupreme Biſhop above 24 Years, and was at laſt crucified with his Head downwards. (7.) The *Roman Catholicks* believe, that the ſame Power and Authority which was veſted in the Apoſtle Peter deſcended to every next ſucceſſive Biſhop or Pope of Rome, by an uninterrupted Succeſſion. (8.) Every ſucceſſive Pope, therefore, they ſay is God's Vicegerent, and ſupreme Head of all Nations, and of every nominal Church on Earth. (9.) They are further taught to believe that he has a Power to create or ſet up Kings, and to depoſe them; and to ordain Biſhops and Prieſts, and excommunicate them at Pleaſure. (10.) They believe that the Pope has a Power to grant Indulgencies to break through all Oaths and Promiſes, and to allow of all Manner of Sins, and then abſolve them. (11.) They believe in a Purgatory, or Place of Fire, to purify the Souls of the departed; and that the Prieſts by offering up or ſaying Maſs, can deliver their Souls from this State of Priſon and Miſery, and trans-

fer them into Joy and Bliſs*. (12.) They believe that Jeſus Chriſt, after he was crucified, deſcended perſonally into Hell, and releaſed from thence all the Souls of the former Saints. (13.) They aſſert that the bleſſed Virgin *Mary* is the Mother of God, and that ſhe atones for the Souls of them that adore and worſhip her on Earth: Therefore her Picture, with the Picture of other Saints, ought to be had in great Reſpect and Veneration. (14.) They profeſs to do Works of Supererogation, and therefore they frequently ſell good Works to the ignorant, and tell them that they will expiate any Crime. (15.) Their mendicant Prieſts go in a very naſty and bad Dreſs, to make the Laity believe what Poverty they ſuffer for the Name of Jeſus, though at the ſame Time they are very rich; for by this crafty Piece of Hypocriſy they excite Pity and Compaſſion, and get a great deal of Money. (16.) They believe there are ſeven Sacraments, viz. *Baptiſm*, *Confirmation*, the *Euchariſt*, *Penance*, *extreme Unction*, *Orders* and *Marriage*. (17.) They forbid the eating of Fleſh in the Time of Lent, and on certain Faſt Days; but notwithſtanding their ſtrict Orders of Abſtinence and Faſting, they will eat, gorge, and gormandize Fiſh and other Things moſt profuſely. Thus, *Phariſee*-like, they ſtrain at Gnats and ſwallow Camels. (18.) They impoſe upon the Ignorant and Unthinking, to believe the ridiculous Doctrine of *Tranſubſtantiation*; that is, after the Prieſt has bleſſed or conſecrated the Bread and Wine in the Sacrament, the Symbols or Elements are then no more Bread and Wine, but really the very Body and Blood of our Lord Jeſus Chriſt: And what renders this ſo ſhocking is, that though they impoſe it upon the Laity as a very material Article of their Faith, they themſelves know it is quite repugnant to Faith itſelf, is a ſelf-evident Contradiction to the Word of God, and the philoſophical Law of Matter, and immediately contrary to Reaſon itſelf. (18.) Notwithſtanding theſe

* ☞ It is to be obſerved, that thoſe who leave Legacies to the Prieſts, or have rich and good Friends, their Souls are conſtantly prayed for, though 'tis many Years before they are releaſed, and coſt a great deal.—But Dean *Swift* ſays, no Money, no *Pater Noſters*; therefore the Poor may lie in Purgatory and be d—mn—d.

abominable

abominable and flagrant Abſurdities, yet they are very jealous and zealous in the Cauſe of their Religion, or rather Superſtition, making it a damnable and heinous Sin in all ſuch as will not adhere moſt ſtrictly to their infallible Dictates. (19.) They are exceedingly laborious to gain Converts, by a particular Method and a long unwearied Patience, and Diligence in every Country but their own, to bring over ignorant Souls by Flatteries and fair Promiſes; but it is not ſo where they have Power, for then they inſiſt upon a Belief and Compliance with every Thing; otherwiſe their Love is turned into Cruelty, their Zeal into Inhumanity, and their Perſuaſions into bloody Inquiſitions. (Laſtly,) Theſe and many other ridiculous Impoſitions, and many Cruelties continually impoſed upon the Conſciences and Perſons of Men in all Nations, occaſioned a large Body of People to *diſſent*, *ſeparate* from, and *proteſt* againſt Popery or the *Romiſh* Church, and therefore are called *Proteſtants*, be they of what Sect or Denomination they pleaſe; and the Church of *Rome*, without Diſtinction, call all ſuch Proteſtants *Heretics*, and they all partake of her *Anathema's* and execrable Curſes to this Day.

Tyr. One would hardly believe that a Church which pretends to have its Sanction from God, and its Examples from his holy Apoſtles, can poſſibly be ſo ridiculous in its Principles, and ſo cruel in its Practice.

Phil. This the Hiſtory of all Nations ever allowed of; *England* has ſeverely felt her Rod, and the *Proteſtants* of many neighbouring Nations are not Strangers to her ſuperſtitious Follies and her cruel Inquiſitions and Perſecutions to this Day.

N. B. As there are many Perſons who are not eaſily perſuaded that the Tenets of the Church of *Rome* are ſo bad as are generally ſpoken of, I have been the more particular in pointing them out; and as there are many of the *Roman Catholic* Perſuaſion, who would fain poſſeſs the more ignorant Part of Mankind, that the Church of *Rome* is the beſt of Churches, and the Stories concerning the many Cruelties againſt the Proteſtants are all falſe: But that the Reader may ſee what Love they bear to all other Sects and Perſuaſions of Men, I thought proper to inſert the following Lines, in order to caution every Perſon to take Care how they are led aſide by the plauſible Inſinuations of her Prieſts, or the pretended Love of her Emiſſaries, while they lie perpetually under their execrable Curſes and Imprecations.

Here follows the Pope's dreadful Curſe upon Heretics; being the ſolemn Form of *Excommunication*, and which may be ſeen in the Ledger Book of the Church of *Rocheſter* in *Kent*.

The Pope being ſeated, and every Thing ready for ſuch a Solemnity, he, or ſome Delegate appointed, pronounces againſt all other Churches, Sects, and Perſuaſions of Men, as follows.

1. *The Declaration alone.*

" By the Authority of God Almighty, the Father, " the Son, and the Holy Ghoſt; and alſo of the holy " Canons, and of the undefiled Virgin *Mary*, Mother " and Patroneſs of our Saviour, and of all the celeſtial " Virtues, Angels, Arch-angels, Thrones, Domi- " nions, Powers, Cherubims, and Seraphims; and of " the holy Patriarchs, Prophets, Apoſtles, Evangeliſts, " and of all the holy Innocents, who in the Sight of " the Holy Lamb are found worthy to ſing the new " Song of the holy Martyrs, holy Confeſſors, holy " Virgins, and of all the Saints, together with all the " Holy of God, we do *hereby*, excommunicate and a- " nathematize *him* or *them*, Malefactor or Malefactors. " ——And from the Threſholds of the holy Church of " God Almighty, we ſequeſter that *he* or *they* may be " tormented, diſpoſed of, and delivered over with *Da- " than* and *Abiram*, and with thoſe that ſay unto the " Lord God, Depart from us. And as the Fire is " quenched with Water, ſo let the Light of *him* or *them* " for evermore, unleſs it ſhall repent *him* or *them* to " make Satisfaction. *Amen.*"

2. After this Declaration the Curſes follow, which are repeated by the whole Aſſembly, then gathered together.

" (1.) May the Father, who created Man, curſe *him* " or *them*. (2.) May the Son, who ſuffered for us, " curſe *him* or *them*. (3.) May the Holy Ghoſt, who " was given to us in our Baptiſm, curſe *him* or *them*. " (4.) May the holy Croſs, which Chriſt for our Sal- " vation triumphing over his Enemies, aſcended, curſe " *him* or *them*. (5.) May the holy and eternal Virgin

" *Mary*

" *Mary*, Mother of God, curſe *him* or *them*. (6.) May " St. *Michael*, the Advocate of holy Souls, curſe *him* " or *them*. (7.) May all the Angels and Arch-Angels, " Principalities and Powers, and all the heavenly Hoſts, " curſe *him* or *them*. (8.) May St. *John*, the chief " Forerunner of Chriſt, curſe *him* or *them*. 9. May " St. *Peter*, St. *Paul*, and St. *Andrew*, and all other of " Chriſt's Apoſtles, together with the reſt of his Diſ- " ciples, and four Evangeliſts, who by their Preaching " converted the whole univerſal World, curſe *him* or " *them*. (10.) May the holy and wonderful Company " of Martyrs and Confeſſors, who by their holy Works " are found pleaſing to God Almighty, curſe *him* or " *them*. (11.) May the holy Choir of the holy Vir- " gins, who for the Honour of Chriſt have deſpiſed the " Things of this World, curſe *him* or *them*. (12.) May " all the Saints, who from the Beginning of the World " to everlaſting Ages are found to be beloved of God, " curſe *him* or *them*.

" (13.) May *he* or *they* be curſed whereſoever they " be, whether in their Houſe, or the Field, or the " Highway, or the Path, or in the Wood, or in the " Water, or in the Church. (14.) May *he* or *they* be " curſed in living, in dying, in eating, in drinking, in " being hungry, in being thirſty, in faſting, in ſleep- " ing, in ſlumbering, in waking, in walking, in ſtand- " ing, in ſitting, in reſting, in p—ſſ—g, in ſh—tt—g, " and in Blood-letting.

" (15.) May *he* or *they* be curſed in all the Faculties " of their Body. (16.) May *he* or *they* be curſed in- " wardly and outwardly. (17.) May *he* or *they* be " curſed in the Hair of *his* or *their* Head. (18.) May " *he* or *they* be curſed in *his* or *their* Brain. (19.) May " *he* or *they* be curſed in the Top of *his* or *their* Head, " in their Temples, in their Forehead, in their Ears, " in their Eyes and Eye-brows, in their Cheeks, in " their Jaw-bones, in their Noſtrils, in their Teeth, " in their Lips, in their Throats, in their Shoulders, " in their Wriſts, in their Arms, in their Hands, in " their Fingers, in their Breaſt, in their Heart, and in " the interior Part of their Stomach, in their Reins, in " their Thighs, in their Genitals, in their Hips, in

" their

" their Knees, in their Legs, in their Feet, in their " Toes, in their Nails. (20.) May *he* or *they* be curſed " from the Crown of their Head to the Sole of their " Feet, may there be no Soundneſs in *him* or *them*.

" (21.) May the Son of the living God, with all the " Glory of his Majeſty, curſe *him* or *them*, and may " Heaven, with all their Powers that move therein, riſe " up againſt *him* or *them*, to damn *him* or *them*, unleſs " they ſhall repent, to make Satisfaction. *Amen. Amen.* " So be it."

Tyr. Never did I hear any Thing ſo ſhocking as this is! I ſhould think this very unpolitical as well as wicked.

Phil. In *Italy*, and Places more immediately under the Pope's Juriſdiction, it may perhaps be political; but plain it is, that through this *abſolute*, *tyrannical*, and *perſecuting* Spirit, the Church of *Rome* has loſt Ground, and has been a ſinking Church ever ſince the glorious Reformation under *Martin Luther*, in the Reign of *Harry* the Eighth, *Ann. Dom.* 1517, and *ſhe* is deſpiſed by all Nations on Account of her Cruelties and Perſecutions. Read *Henry* and *Whiſton*, as alſo the Margin of Queen *Elizabeth*'s Bibles on the xiii. xiv. xv. xvi. xvii. xviii. and xix. Chapters of the *Revelations*.

Tyr. You are extremely obliging, and I am as thankful; and now pray tell me what followed after the Reformation?

Phil. The eſtabliſhed Church, commonly called the Church of *England*.

2. *Of the Church of* England.

Tyr. What do you mean by the Church of *England?*

Phil. The Religion and Worſhip of the People of *England*, as by Law eſtabliſhed, and it is governed by two Arch-Biſhops, Biſhops, and inferior Clergy, of which the King is Head.

Tyr. What are the principal Tenets of the Church of *England?*

Phil. You may ſee the Principles of this Church very particularly ſet forth by and in thirty-nine Articles, printed and publiſhed in their Book of Common Prayer, or Manner of Worſhip.

Tyr.

Tyr. But I wiſh you would give ſome ſhort Account of the principal Tenets of the Church of *England*, as it may be of Service to ſuch of its Members, who do not really know them; and alſo remove the Prejudice of many others, who accuſe it unjuſtly.

Phil. You are very right. Therefore I ſhall give you an Account of it, according to its own Articles, and not according to the Opinion of modern Writers.

Tyr. Why ſo, Sir?

Phil. Becauſe the Clergy themſelves are divided into two Sorts; ſome being *Calviniſts*, others *Arminians*.

Tyr. Sir, I am ſatisfied; proceed then, if you pleaſe, to acquaint me with the Admirers of the Church of *England*, according to its Articles or firſt Eſtabliſhment.

Phil. I will. (1.) The Church of *England* has thirty-nine Articles, ſome contain the Matter of Faith which relate to the Church of God, and others are civil Articles relating to its Government, Order, and Diſcipline. (2.) The 1ſt, 2d, 3d, 4th, and 5th Articles ſet forth that there is but one living and true God; that in the Godhead there are three Perſons, Father, Son, and Holy Ghoſt, all equal in Power, Majeſty, and Glory; that the ſecond Perſon in this Trinity took our Nature upon him, and is both God and Man united in one Chriſt; that he was crucified for us in the Fleſh, was buried, roſe the third Day from the Dead, according to the Scriptures, that he aſcended into Heaven, and there makes continual Interceſſion for us. (3.) They own (in Art. nine) original Sin, and that by *Adam*'s firſt Diſobedience or Tranſgreſſion all Mankind are tainted or infected with Evil, have a natural Inclination to Evil, and therefore are obnoxious to the Wrath of God. (4.) In Article ten, they ſay, that Man's Condition ſince the Fall is ſuch, that he has no Power, or free Will, of himſelf, to do good Works acceptable to God, without the Grace of God working with him. (5.) The ſeventh Article affirms, that we are juſtified by Faith only, and are counted righteous before God, for or through the Merits of Chriſt only. (6.) The Twelfth Article recommends the Practice of good Works, and ſays, they are the Proofs of a true Faith. (7.) This Church teaches us in Article thirteen, that Works done before

before Juſtification, or before Grace is given, cannot be pleaſant to God, nor doth make us meet to receive Grace, as they ſpring not from a true and lively Faith. (8.) The fourteenth Article flatly denies the Works of Supererogation, and acknowledges that when we have done all we can poſſibly do, we are ſtill unprofitable Servants. (9.) The ſeventeenth Article treats of the Doctrine of Election and Predeſtination. (10.) The eighteenth Article ſays, that the Church holds all Perſons accurſed who ſhall preſume to ſay that any Man is ſaved by the Law, or by any Sect, Profeſſion, or Perſuaſion. (11.) The twenty-ſecond Article denies the *Romiſh* Doctrine of Purgatory, paying Adoration to Angels and Reliques of Saints. (12.) The twenty-ſeventh and twenty-eight Articles acknowledge two Sacraments only, *viz.* Baptiſm and the Lord's Supper, and ſay, that after Conſecration they are ſtill but Bread and Wine, and both are to be received by the Faithful only, in Commemoration of the Body and Blood of Chriſt, broken and ſpilt upon the Croſs. (13.) The Church holds Infant Baptiſm, requires Godfathers and Godmothers, and marks the Child in the Forehead with the Sign of the Croſs. (14.) Theſe are the Articles relating to the Tenets of the Church of *England*; the other Articles contain only Rules and Orders concerning its Government and Diſcipline.

Of their Manner of Worſhip.

1. The Church of *England* worſhip God, firſt, by confeſſing of Sins, then calling upon his Name in Prayer, Praiſes, and ſinging of Pſalms. The Collects are ſhort Prayers uſed by the Miniſters and People, are allowed to be well ſuited to almoſt all Occaſions; and the whole Way and Manner of its Worſhip may be ſeen in the Book of Common Prayer.

2. As the *Romiſh* Church call all Heretics who ſeparate from her Communion, ſo the Church of *England* call all that ſeparate from her Communion *Schiſmatics*.

3. As the Proteſtants ſeparate from the Doctrines of the Church of *Rome*, on Account of its Errors and Superſtitions, ſo a certain Set of Men (formerly called *Puritans*) ſeparated from this Church under the pretended Notion

Notion that ſeveral of its Forms and Ceremonies were unwarrantable, and that their Conſcience could not bear them.

4. All other Sects who profeſs Proteſtantiſm in *England*, but are not of the eſtabliſhed Church, are called *Diſſenters*.

5. The *Diſſenters* are divided into many other Sects, *viz. Preſbyterians*, *Independents*, *Baptiſts*, commonly called *Anabaptiſts*, *Quakers*, *Arians*, *Arminians*, *Antinomians*, *Socinians*, *Muggletonians*, &c. but the moſt noted or popular of theſe are the *Preſbyterians*, *Independents*, and *Quakers*.

1. PRESBYTERIANS.

Tyro. What do you mean by *Preſbyterians?*

Phil. All thoſe Perſons who deny Epiſcopacy, or the Government of the viſible Church by Biſhops; or thoſe who aſſert that the Church ſhould be governed by *Elders* or *Preſbyters*.

Tyr. In what Manner then do they chooſe their Miniſters?

Phil. By taking a Choice out of ſeveral Perſons, whom the Elders firſt examine in Principles and Abilities, and when they have fixed upon a Paſtor, Teacher, or Miniſter, they elect, nominate, or ordain him by Faſting, Prayer, and Impoſition of Hands. See Acts, Chap. i. ver. 23. to the End.

Tyr. How do they govern their Church?

Phil. All common Affairs in every particular Church or Aſſembly are regulated by their *Miniſter* and *Elders*. (2.) If there are Things ariſe which require more Judgment to determine, they then appeal to the Miniſters and Elders of other Congregations. (3.) They have yet an higher Appeal than this; and in Caſe of Differences and Diſputes, they call a Court or Synod of the moſt able among them, who accordingly meet to regulate all Affairs, and adjuſt every Thing to the Satisfaction of inferior Congregations.

Tyr. Very well, Sir; and pray what are their chief Tenets, and Manner of Worſhip?

Phil. Their Tenets, concerning God, the Trinity, the Sufferings of Chriſt, *&c. &c.* are equally the ſame

as

as that of the Articles of the Church of *England*; and they baptize Infants by ſprinkling, and have Sponſors for them as the Church has, but abominate the Name of Godfather and Godmother.

Tyr. What is their Manner of Worſhip?

Phil. They don't uſe any Form of Prayer, but their Worſhip conſiſts in *extempore* Prayer, Preaching, and ſinging Pſalms, but ſome of them frequently finiſh their Prayers with the Lord's Prayer. Theſe Sects are rather *Arminians* than *Calviniſts*.

2. INDEPENDENTS.

Tyr. What is meant by *Independents?*

Phil. The Word itſelf carries its own Meaning with it. They are a Sect who profeſs themſelves *independent* of all other Churches or Perſuaſions, of all Councils, Synods, and Juriſdictions, and ſay every Church or Aſſembly of Men have a Power lodged in themſelves; and therefore deny all Superiority and Subordination.—Their Worſhip is the ſame as the *Preſbyterians*, and their Tenets much the ſame, except it be that they hold a particular Redemption, and are in general rather *Calviniſts* than *Arminians*.

3. ANABAPTISTS *or* BAPTISTS.

Tyr. What do you mean by *Anabaptiſts?*

Phil. They are ſuch who oppoſe the Baptiſm of Infants, ſay it is unwarrantable, and that none are proper Objects of this firſt Sacrament but adult Perſons, and ſuch as are capable of giving Account of their Faith in *Chriſt Jeſus*, and believe that it is an Ordinance that he enjoined all his Diſciples to follow. They ſay further, that ſprinkling with Water is not Baptiſm, but an Innovation, contrary to the Rules of Scripture, and that therefore no Perſon is truly Baptized, who is not dipped into, or buried under Water, in the Name of the Father, Son, and Holy Ghoſt.

Tyr. To dip or plunge into Water is certainly the Method pointed out in Scripture.———But pray, from whence ſprang this Sect, what are their Tenets and Manner of Worſhip?

Phil.

Phil. They appeared firſt in *England* in 1521, and were the Followers of *Nicholas Storck*, *Mark Stubner*, and others, who were Diſciples of *Martin Luther*, in the Time of *Henry* VIII. (2.) Their Manner of Worſhip is alſo *extempore* Prayer, Praiſes, Preaching, and ſinging Pſalms. (3.) Their Government or Diſcipline is alſo by Elders, and their Principles are according to the ſeventeenth Article of the Church of *England*, being very ſtrong Predeſtinarians.

4. QUAKERS.

Tyr. Why are this Sect called *Quakers?*

Phil. Becauſe at firſt when they ſpoke or preached they had violent Shakings or Agitations.

Tyr. Who was their firſt Teacher, and what are their principal Tenets?

Phil. Their firſt Leader was one *George Fox*, in the Year 1650, who taught that the Light within is more ſufficient to guide Men to Heaven than the Holy Scriptures; but they are now greatly reformed, and pay a great Regard to God's Word, but ſtill deny the two Sacraments, and all Manner of Ceremonies. (2.) They refuſe to take any Oath before a Magiſtrate, and therefore are indulged to give their Affirmation as Witneſſes. (3.) Their Worſhip is very abrupt, any Perſon riſing up to pray or preach according as he is moved. (4.) They pray and then preach, or inſtruct their Congregations in all moral Duties, and ſpeak continually againſt the Modes, Vanities, and Vices of the Age. (5.) They are very plain and ſimple in their Dreſs, and as for Order and Diſcipline in governing their different Aſſemblies and Congregations, and for Unity, Harmony, and brotherly Love, they really exceed any Chriſtian Sect of People or Church in the Univerſe.

Of the leſſer or more private Sects.

1. *Arians*, or the Followers of *Arius*, who in the Time of *Conſtantine the Great*, *A. C.* 315, taught that the Son of God is not equal or conſubſtantial with the Father, but only the firſt of all created Beings. His Opinion was condemned as heretical by the Council of *Nice* in *A. C.* 321; but notwithſtanding this, they infected

fected the eaſtern Churches with their Principles, and though they are not a Church or Sect of themſelves, yet they are very numerous to this Day in ſeveral Churches, but particularly in that Church, whoſe Articles teach them quite the contrary.

2. *Arminians*, thoſe who adhere to the Doctrine of *Arminus*, who ſeparated himſelf from the *Calviniſts* in the ſixteenth Century, and taught that Predeſtination is grounded on foreſeen Works of Righteouſneſs; that a Man has Power of himſelf to embrace or reject the Motions of the Holy Spirit; and that he may finally fall from Grace after Juſtification.

N. B. Though there is no particular Sect or Church in *England* under the Nomination of *Arminians*, yet they are very numerous in all the reformed Churches, except among the Baptiſts.

3. *Antinomians*, a Sect who reject not only the *Moſaic* Law of Ceremonies, but that aſſert alſo that all Manner of good Works, ſuch as Honeſty, Charity, Sobriety, Temperance, Chaſtity, *&c.* are of no Signification, becauſe good or evil Works neither forward nor hinder a Man in his Salvation; that our Righteouſneſs is already fully complete in the Offering of *Chriſt*, and that whoever believes faithfully that the Work of Redemption is already finiſhed, it is ſufficient, whatever may be his Life and Converſation. There are ſeveral of this Sect in *London*, but the two moſt noted Teachers among them were *Cudworth* of *Oxford Market*, and the famous *J. Relly*, of *Coach-Maker's Hall*, *London*.

4. *Socinians*, are ſuch who follow the Doctrine of one *Fauſtus Soninus*, who taught that *Jeſus Chriſt* was only mere Man, and had no Exiſtence before the Virgin *Mary*.

5. *Calviniſts*, or *Superlapſarians*, the Followers of the noted Reformer *Calvin*, who taught that Predeſtination is abſolute and unconditional from all Eternity, and that God elected certain Perſons before the Foundation of the World to eternal Salvation and Holineſs of Life.

6. *Lutherans*, the Followers of *Martin Luther*, the noted Reformer in the Reign of *Henry* VIII. He wrote againſt Pope *Leo* X. concerning the Abuſe of Indulgencies; his chief Tenets were a firm Belief in the Trinity,

Trinity, and that we are juſtified by Faith only in *Jeſus Chriſt*.

7. *Muggletonians*, the Followers of *Lodewick Muggleton*, a Journeyman Taylor, who with one *Reeves* in the Year 1647, taught the People that God himſelf left his Glory in Heaven, under the Government of *Moſes* and *Elias*, and came down and ſuffered Death on the Croſs. They deny the Trinity, the Immortality of the Soul, and ſay they have a Power of ſaving and damning. They frequently aſſemble together in Fields, and in the Evening both Sexes meet at Alehouſes or Places appointed, where, after ſome Sort of Preachment, the Lights are immediately put out, and by the Actions that follow, it is evident that they don't believe the Soul is immortal. The public Place of their Aſſemb y is in *Old-Street Square*, and *Barnaby-ſtreet*, *Southwark*.

Tyr. This is a ſtrange Sect, indeed!—But pray what do you call *Methodiſts?*

Phil. It is a Name given to all ſuch Perſons whoſe Way and Method is to preach in the Fields, or at the Head of any Street; but it is a Name more particularly given to the Followers of Mr. *Whitfield* and *Weſtley*. But you are to note, that there is as much Difference between *Whitfieldians* and *Weſtleyans* as between any two Sects, the former believing that Salvation is obtained by Faith alone in *Chriſt Jeſus*, and that the Love of *God* to his Elect cannot be broken off: Whereas the other Sect believe a Man is juſtified by Works and Grace, and that it is poſſible for a Man to go on in Degrees of Holineſs till he arrives at laſt even to a State of Perfection in this Life. The principal Places of Worſhip for the *Whitfieldians* are the Tabernacles in *Moorfields* and *Tottingham-Court* Road; and Mr. *Weſtley*'s principal Place is the *Foundery* in *Moorfields*.

Tyr. I am obliged to you, Sir, and pray are there any more Sects or Profeſſions worthy our Notice?

Phil. Not that I know of at preſent; for all the others are blended, compounded, or intermixed with thoſe already ſpoken of, in ſome reſpect or other.

Tyr. But you will be pleaſed juſt to mention them by Name.

Phil

Phil. I will. (1.) *Cainites.* (2.) *Eutychians.* (3.) *Ebionites.* (4.) *Eunomeans.* (5.) *Fataliſts.* (6.) *Gnoſtics.* (7.) *Libertines.* (8.) *Millenarians.* (9.) *Materialiſts.* (10.) *Neſtorians.* (11.) *Origeniſts.* (12.) *Pelagians.* (13.) *Solifidians.* (14.) *Sublapſarians.* (15.) *Supralapſarians.* (16). *Stoics.* (17.) *Anti-Trinitarians, &c.* All or any of which you may ſee at Leiſure.

SECT. X.

Of the heathen Mythology, or a conciſe Account of the Hieroglyphics of the heathen Deities.

Tyr. What do you mean by *Mythology?*

Phil. A general Account of the fabulous Hiſtory of the Gods of the Heathens.

Tyr. What is the Uſe of *Mythology?*

Phil. It furniſhes our Minds with many Things neceſſary to be known, in order that we may underſtand the Writings of many great Men; but particularly thoſe Works which are wrote in Rhyme or Blank-verſe, in which you will find Similies and Alluſions run continually through the Work, and therefore, for Want of being acquainted with *Mythology*, you cannot well underſtand the Deſign of ſuch Authors, who draw Illuſions from fabulous Hiſtories of this Sort.

Tyr. I know it; therefore I want ſome Inſtructions in theſe Things, and hope you will treat a little upon them.

Phil. I will; and here follows

An Alphabetical Account of the Heathen Deities.

N. B. As I have very little Room for a Subject which requires a Volume, I was obliged to treat upon it in the following Order, which is ſufficient to give the Reader ſome Idea of theſe Things; but if he has a Fancy hereafter to read more fully concerning it, let him conſult *Boyſe*'s new *Pantheon.*

(1.) *Acheron*, Son of *Titan* and *Terra*; he furniſhed the *Titans* with Water when they fought againſt the Gods, and therefore they turned him into a River in Hell; but others ſay *Acheron* always was a River, but afterwards was made or converted into a ſulphureous or ſtinking Lake.

(2.) *Achilles*,

(2.) *Achilles*, Son of *Piletes* and *Thetis*; his Mother *Thetis* was ſo fond of him that ſhe fed him duly with *Ambroſia*, and at Night covered him with celeſtial Fire, and alſo dipped him into the River *Styx*, by which all his Body became invulnerable except juſt the Heel ſhe held him by. He afterwards was Pupil to the Centaur *Chiron*, who told him he would certainly be killed at the Siege of *Troy*, which was done by *Paris*, who, with a poiſonous Arrow, ſhot him in the Heel, and mortally wounded him.

(3.) *Actæon*, Son of *Ariſtæus*, a noted Prince for Hunting; but being curious to look at *Diana* while ſhe was bathing herſelf, ſhe changed him into a Stag, whom his own Dogs purſued and killed.

(4.) *Adonis*, the Son of *Cynaras*, King of *Cyprus*, and the Favourite of *Venus*. *Mars* turned himſelf into a wild Boar, and *Adonis* hunting it too eagerly, it turned and bit him in the Groin and killed him: *Venus* flying to his Succour, ran a Thorn into her Foot, from whence the Blood falling upon a Roſe, turned it into a *Carnation*, and his Blood ſhe changed into a Flower, called *Anemone*.

(5.) *Æolus*, Son of *Hippotes*, and God of the Winds in general. See *Boreas*.

(6.) *Æſculapius*, God of Phyſic; one of the Sons of *Apollo*, by the Nymph *Coronis*. He was killed by *Jupiter*, becauſe *Pluto* complained he did ſo many Cures, he decreaſed the Number of the Dead.

(7.) *Amphion*, Son of *Jupiter* and *Antiope*; he was ſuch an excellent Performer on the Lyre, that he even raiſed the Walls of *Thebes* by Harmony.

(8.) *Amphitrite*, Wife of *Neptune*.

(9.) *Apollo*, God of Light and Muſic, Son of *Jupiter* and *Latona*; he is repreſented in various Attitudes, but always accompanied with a Harp or Lyre in his Left-Hand.

(10.) *Ariadne*, the favourite Wife or Miſtreſs of *Bacchus*, whoſe Crown is placed among the Conſtellations.

(11.) *Argus*, was one employed by *Juno*, to wait *Jupiter*'s Motions with *Io*: He had an hundred Eyes; two of which only ſlept, till *Mercury* lulled him to Sleep,

Sleep, and cut off his Head: But *Juno*, in Honour of his Services to her, transformed his Eyes into the Tail of a Peacock.

It is common when we find a very diſcerning, penetrating Man, to ſay, "He has as many Eyes as *Ar-*" *gus:*" Or when we undertake to contrive any Thing by Cunning and great Privacy, we ſay, by Way of Alluſion: "Had he the Eyes of *Argus* he never could "ſee or diſcover it."

(12.) *Aſteria*, Daughter of *Cæus*, who was accounted very modeſt, yet at laſt was defiled by *Jupiter* in the Form of an Eagle.

(13.) *Aſtrea*, the Goddeſs of Juſtice and Equity, Daughter of *Jupiter* by *Themis:* She is repreſented with her Eyes bound or covered over, having in one Hand a Pair of balanced Scales, and in the other a Sword, to ſhew Juſtice is not biaſſed, but acts of herſelf impartially. She was moved to Heaven for her Uprightneſs, and tranſlated into the Conſtellation, or one of the twelve Signs called *Virgo*, or the Virgin.

(14.) *Atlas*, Son of *Jupiter* and *Clymene*; he was a great Lover of Aſtronomy and Geography, and therefore is repreſented bearing the whole Earth or Sphere upon his Shoulders.

(15.) *Augeas*, King of *Elis*, who was ſaid to keep 3000 Oxen at a Time in one Stable, but as it had not been cleared for thirty Years, it was very noxious; and therefore he hired *Hercules* to clean it, and promiſed him the Tenth of the Beaſts. *Hercules* performed it by turning the Courſe of the River *Alpheus*; but *Augeas* would not ſtand to his Bargain, therefore *Hercules* killed him for his Perfidy.

(16.) *Aurora*, Goddeſs of Light, and Harbinger of *Titan*, or Meſſenger of the Sun; ſhe was Daughter of *Hyperion* and *Theia*; ſhe bore *Phaeton* to *Cephalus:* But her greateſt Favourite was *Tithonus*; ſhe got him tranſlated to Heaven, and after that into a Graſshopper, which every Year change or caſt their Coat or Skin, and then will chirp afreſh and become lively. This Goddeſs is repreſented too many Ways to ſpeak of here; but in common ſhe is painted or pictured riding in a golden

golden Chariot; upon her Head is the Morning Star, and her Attendants are the *Dawn* and *Phœbus*.

(17.) *Bacchus*, God of Mirth and Wine. He was Son of *Jupiter* and *Semele*; he is called by a great many other Names or Appellations, viz. *Dionyſius*, *Briſæus*, *Bimater*, *Burgenes*, *Tauriformis*, *Nyctilious*, &c. He is repreſented in various Shapes, ſometimes mounted on a Tiger; by others a very corpulent Youth, naked, with a very ruddy Face, crowned with Ivy and Vine-Leaves, with a Thyrſus or Stalk in one Hand, and with the other pouring Wine into an Horn: But in general he is repreſented ſtriding acroſs a Caſk, with Glaſſes in his Hand, and Mirth and Jollity in his Countenance.

Hence all ſuch as are given too much to the Bottle are called *Bacchanalians*.

(18.) *Bellona*, the Goddeſs of War, and Wife or Siſter to *Mars*. She is repreſented various Ways, ſometimes driving a Chariot with Violence, and ſometimes with a lighted Torch or Trumpet in her Hand; her Hair compoſed of Snakes, and her Garments ſtained with Blood.

(19.) *Cacus*, Son of *Vulcan*, and a noted Robber, killed by *Hercules*.

(20.) *Cælus*, called ſometimes *Uranus*, the Offſpring of *Terra* or *Gaia*, and the Father of the Sky or Firmament.

(21.) *Cæculus*, the third Son of *Vulcan*. His Mother conceived him by Means of a Spark flying into her Lap while ſhe ſat by the Fire. He is repreſented with very ſmall Eyes.

(22.) *Caliſto*, Daughter of *Lycaon*, and one of the Nymphs of *Diana*: She was debauched by *Jupiter*, and afterwards tranſlated into the Northern Conſtellation called the Bear.

(23.) *Caſtor* and *Pollux*, two twin Brothers, Sons of *Jupiter* by *Leda*, Wife of *Tyndarus* King of *Sparta*; they were both made a Conſtellation in Heaven, called *Gemini*. They are repreſented like two beautiful twin Youths, riding on white Horſes, with Stars in their Helmet.

(24.) *Cecrops*, thoſe who took Wages of *Jupiter* to fight againſt *Titan*, but afterwards would not; therefore were turned into Apes.

(25.) *Cephalus* ſhot his Wife *Procris* undeſignedly, with one of the unerring Arrows, which his beloved *Aurora* had furniſhed him with.

(26.) *Cerberus*, *Pluto*'s Maſtiff, called the three-headed Dog of Hell, born of *Typhon* and *Echidna*; he fawned upon all who entered the infernal Regions; but infallibly devoured all who attempted to eſcape. *Hercules* dragged him from Hell in ſpite of his Maſter *Pluto*; but the Monſter continually vomited Fire and Foam of Poiſon, which, wherever it fell, produced that deadly Herb called *Aconite* or *Wolf's-bane*.

(27.) *Ceres*, the Goddeſs of Corn and Plenty, Daughter of *Saturn* and *Rhea*; ſhe is alſo called *Magna Dea*, or the Great Goddeſs; alſo *Aletrix* and *Mammoſa*, from her nouriſhing all Seeds and Plants. She firſt taught the Art of Plowing and Sowing. She turned *Abas* into a Neut or Water Lizard. She loved *Jaſon*, Son of *Jove*; but *Jove*, jealous of him, killed him with a Thunderbolt. She is repreſented very majeſtic and fair, yellow Hair, crowned with Poppies, holding in her right Hand Ears of Corn, and ſometimes in her left a lighted Torch; and at other Times in a Chariot or Car, drawn by winged Dragons or Lions.

(28.) *Chaos*, according to *Heſiod*, the Father of the Gods; but it is evident this is a Jumble, for which that famous Heathen Poet loſt great Credit. *Abraham Depenbeke* attempted to paint *Chaos*; but though the Work was performed well, yet there was ſuch a Medly of Light and Darkneſs, *&c.* wrong placed, that the whole Deſign was ſpoiled, and became ridiculous. See the *Pantheon*, P. 2.

(29.) *Charon*, the Son of *Erebus* and *Nox*. He is called the Ferryman of Hell, becauſe he uſed to ferry Souls over the Rivers *Acheron* and *Styx*. He is repreſented as a fat, rough-looking old Man, with a buſhy grey Beard, with running Eyes, and cloathed with Rags, or very tattered Garments.

(30.) *Cupid*, the God of Love; there are various Opinions of his Pedigree; but it is generally ſuppoſed, that

that he was the Son of *Mars* by *Venus*. He is repreſented blind, to ſhew that real Love ſees no Faults; and is alſo armed with a Bow and Quivers, or darting Arrows, to ſhew the Paſſion of the Mind through the Channel of the Eye; and with Wings, to ſhew plainly that nothing is more fleeting than the ſudden Paſſion of Love. He is the favourite Boy of *Venus*, and her conſtant Attendant in her Amours.

(31.) *Cybele*. See *Veſta*.

(32.) *Cyclops*, Sons of *Neptune* and *Amphitrite*. They were Slaves or Journeymen to *Vulcan*, and uſed to forge Thunderbolts, *&c.* They had but one Eye, which was in the Middle of their Forehead.

(33.) *Deianira*, Wife of *Hercules*, and the Cauſe of his Death. See *Hercules*.

(34.) *Diana*, the Goddeſs of Chaſtity, Daughter of *Jupiter* and *Latona*, and Queen of the Woods and Foreſts. She had alſo ſeveral other Names, as *Luna*, *Delia*, *Hecate*, *Cynthia*, &c. Though *Diana* was ſo remarkably chaſte on Earth, yet when ſhe aſcended to the Skies, ſhe had ſeveral Amours. She had a Daughter by her Father *Jupiter*, whoſe Name was *Erſa*, or the *Dew: Pan* alſo defiled her in the Form of a white Ram; but her Favourite was *Endymion*. *Diana* is repreſented many Ways, becauſe ſhe cuts a ſhining Figure in Hiſtory; but ſhe is commonly depicted in a high Stature, her Hair diſhevelled, a Bow in her Hand, a Quiver at her Back, a Deer's Skin faſtened to her Breaſt, with a purple Robe turned up to her Knees, and Gold Buckles or Claſps; being always attended with Nymphs in a hunting Dreſs, with Nets, Hounds, *&c.* (2.) As *Hecate*, ſhe is repreſented of exceſſive Height; her Head covered with hideous Snakes; her Feet ſometimes by Serpents; and under this Name and Character ſhe is called Goddeſs of the infernal Regions. (3.) As *Luna*, ſhe is repreſented with a Creſcent on her Head, riding in a Silver Chariot, drawn by white Hinds, and Gold Harneſs, but ſometimes by Mules, and at others by Oxen, becauſe of their Lunar Horns.

(35.) See *Hercules*.

(36.) *Elyſian Fields*; the fictitious Name of a Place for the Happineſs and Reſt of the Juſt and Good after their Departure.

 (37.) *Epi-*

(37.) *Epimethes*, Brother to *Prometheus*, and Huſband to *Pandora*, opened the Box of Evils upon Mankind. See *Pandora*.

(38.) *Europa*, Daughter of *Agenor*, by the Nymph *Melia*, ſeduced by *Jupiter* in the Form of a white Bull; he afterwards tranſlated her into the Conſtellation *Taurus*.

(39.) *Eurydice*, Wife of *Orpheus*.

(40.) *Euryſtheus*, *Hercules*'s Taſk-Maſter. See *Hercules*.

(41.) *Faunus*, Father of the Fauns or Demi-Gods, or Goddeſſes of the Woods.

(42.) *Feronia*, the Goddeſs of Woods and Orchards.

(43.) *Flora*, called alſo *Chloris*, the Goddeſs of Flowers. *Flora* is generally repreſented in a cloſe Habit, holding in her Hands the Flowers of Peas and Beans, *&c.* and the Painters have a great Field of Variety in painting her in ſeveral Attitudes, with Variety of Flowers of all Sorts.

(44.) The *Furies*, three infernal Deities, called Goddeſſes of Horror. Their Names were *Teſiphone*, *Alecto*, and *Megara*. They are repreſented with Hair, compoſed of Snakes, Eyes very fierce and inflammable, Chains in one Hand, and Whips in the other.

(45.) *Galaxy*, the milky Way. See *Juno*.

(46.) The *Gorgons*, four Siſters, of whom *Meduſa* was chief. They are repreſented with Snakes about their Hair, brazen Hands, golden Wings, and Tuſks like wild Boars.

(47.) The *Græ* were three Siſters of the *Gorgons*; they are repreſented like old Women; they had but one Eye and one long Tooth common to all, which they uſed occaſionally as each wanted, called alſo *Lamiæ* and *Empuſæ*.

(48.) The *Harpyes* are *Aello*, *Celeno*, and *Ocypete*, Daughters of *Oceanus* and *Terra*; they are repreſented with their Faces like Virgins, Ears like Bears, Bodies like Vultures, human Arms and Feet, but having very long Claws.

(49.) *Harpocrates*, the God of Silence.

(50.) *Hebe*, the Goddeſs of Youth, Daughter of *Jupiter* and *Juno*; but others ſay ſhe was conceived by *Juno* after her eating immoderately of Lettuces. She was

was ſo beautiful in the Eyes of *Jupiter*, that he made her his Cup-Bearer; but at a Feaſt of the Gods, poor *Hebe*, in waiting, had a Slip with her Foot, and had ſo indecent a Fall that put all in Confuſion, and *Jupiter* diſmiſſed her; but to repair this Loſs and Shame, *Jupiter* married her to *Hercules*. She is called the Goddeſs of all Life and Bloom, from Spring to Autumn; then her Foot ſlips, the Leaves fall, and *Ganymede* ſucceeds her, who was the next Cup-Bearer to *Jupiter*, and ſome ſay was afterwards turned into the Conſtellation *Aquarius*.

(51.) *Hecate*. See *Diana* (34.)

(52.) *Helle*, who, riding the golden Ram, fell off into the Sea between *Europe* and *Aſia*, from thence it is called the *Helleſpont*.

(53.) *Hercules*, the greateſt Demi-God, Son of *Jupiter* and *Alcmena*. *Juno* hated *Hercules*, and cauſed his Mother to be a full Week in continual Pangs by her Enchantment, in the Shape of an old Woman; but *Galanthis* at laſt ran to *Juno*, and told her of the ſafe Delivery of *Alcmena*, upon which the Goddeſs re-aſſumed her Shape, and fled: *Alcmena* was that inſtant eaſy; but *Galanthis*, for her Tidings, was turned into a Weſel. (2.) *Juno*, not content with this, ſent two large Serpents to deſtroy him in his Cradle; but *Hercules*, though ſo young, ſtrangled them both with the Squeeze of his Hands. (3.) His Labours would fill a Volume, therefore it muſt ſuffice to tell you, that *Juno* always ſought his Ruin by many Stratagems. (4.) She ſent the *Nemæan* Lion againſt him, but he tore the furious Animal in Pieces, and wore his Skin as a Trophy of Victory. (5.) He next deſtroyed that formidable Serpent or Monſter *Hydra* [ſee *Hydra*]. (6.) He defeated the *Centaurs*, and took the wild Boar alive; tired *Diana*'s Hind; deſtroyed the Vultures or Birds of Prey in *Arcadia*. (7.) He bound the furious Bull which *Neptune* ſent againſt *Minos*, King of *Crete*. (8.) He ſlew the wild Horſes that breathed Fire, and devoured human Fleſh, which belonged to *Diomede* the Tyrant. (9.) He alſo performed the hard Taſk of *Augeas* [ſee *Augeas*.] (10.) He defeated all the *Amazons*, carried their Queen *Hippolita* to *Theſeus*, and gave her Belt to

his Taſk-Maſter *Euryſtheus*. (11.) He killed *Geryon*, King of *Spain*, who had three Bodies, with all his furious Oxen; his Dragon of ſeven Heads, his Dog of two Heads, and his watchful Keeper. (12.) He ſtole the golden Apples at the *Heſperides*, and killed the Dragon with a hundred Heads, that was ſet to guard them. (13.) *Euryſtheus*, thinking to deſtroy *Hercules*, at laſt commanded him to go to Hell, and fetch *Pluto*'s Maſtiff, *Cerberus*, which he performed; *Euryſtheus* was ſurprized at the Performance, and afterwards ordered *Cerberus* back again. (14.) He releaſed *Theſeus*, chained to a Stone on the Banks of *Acheron*; opened a Paſſage through the *Alps*; ſlew the furious Robber, *Cacus*; with a Number of other heroic Feats; and yet he was ſo captivated with the Love of *Amphalia* Queen of *Lydia*, as even to ſpin amongſt her Women, and ſuffer Female Chaſtiſement. (15.) His Death was occaſioned by his Wife *Deianira*; for the Centaur *Neſſus* offering Violence to her, *Hercules* ſhot him with one of thoſe dreadful Arrows he had dipped in the Blood of *Hydra*, which Arrows poiſon all Things that they enter: *Deianira*, however, grew jealous of *Hercules* on ſeveral Accounts, and at laſt managed it ſo as to get him to put on the poiſonous Garment of *Neſſus*, which he no ſooner had done, but he was taken delirious, ſuffered the moſt excruciating Tortures, and in Agony ran here and there; at laſt came to Mount *Oeta*, where he erected a Pile of Wood, ſet it on Fire, and threw himſelf into it, and was conſumed. *Lycus*, his Friend, followed him in this unhappy Situation, but *Hercules* threw him into the River *Thermopolis*, and he became a Rock; he gave his Arrows to *Philoctetes*, who afterwards buried his Remains in the River *Dyra*. (16.) *Hercules* is depicted ſeveral Ways, but in general in a ſtanding Attitude, with the Skin of the *Nemæan* Lion over his Shoulders, and always reſting upon a large Club; at other Times naked, with his Club.

(54.) *Hermaphroditus*, Son of *Mercury* and *Venus*, who was joined in one Body to *Salmacis*, by her Innovation; from hence ſprang the Hermaphrodites.

(55.) *Heſperus*, the Son of *Atlas*, transformed into the Morning Star.

(56.) *Hya-*

(56.) *Hyacinthus*, *Apollo*'s beloved Boy, turned into the Flower *Hyacinth*.

(57.) *Hyades*, (called *Pleiades*) the ſeven Daughters of *Atlas*. They grieved ſo much for the Death of their Brother *Hyas*, that *Jupiter* changed them into Stars, and they are placed in the Heads of the Conſtellation *Taurus*, and their Riſing and Setting are ſuppoſed to be attended with Rain.

(58.) *Hydra*, a Serpent. See *Hercules*.

(59.) *Hymen*, the God of Marriage, and Son of *Bacchus* and *Venus*. He is repreſented in a very fair Complexion, in a Robe of Saffron-colour, and crowned with the Herb *Amaricus*, or Sweet Marjoram.

(60.) *Hyperion*, Son of *Cælus* and *Terra*.

(61.) *Janus*, called alſo *Biceps*, *Bifrons* and *Didymæus*, the God of the Months and Years; he is repreſented with two Faces, and in general ſignifies the Sun.

(62.) *Jaſon*, Son of *Æſon*, who fetch'd the golden Fleece from *Colchis*.

(63.) *Iris*, Daughter of *Thaumas*, and *Juno*'s favourite Companion and Meſſenger; ſhe is repreſented with ſurpriſing Beauty, with Wings, and riding on a Rainbow.

(64.) *Juno*, Queen of Heaven, and both Wife and Siſter of *Jupiter*. She is alſo called Goddeſs of Marriage and Childbirth; and bears too many Names to be inſerted here, the chief of which are *Lucina*, *Pronuba*, *Juga*, *Domiduca*, *Unia*, *Cinxia*, &c. She was very proud and jealous, and left her Seat in Heaven in a Paſſion; but *Jupiter*, by the Perſuaſion of *Citheron*, had a very beautiful Image, which was called *Platea*, which rode in *Jupiter*'s Chariot, and it was reported ſhe was going to be made Queen of Heaven inſtead of imperious *Juno*; upon this *Juno* returned, and attacked the new Bride, and tore off all her Ornaments; but having found the Deceit, ſhe ſeemed to be pleaſed with the Contrivance, and lived more content and complaiſant with her Huſband. *Juno* ſignifies the Atmoſphere. She was given to reſent every Trifle, but none felt her Reſentment more than *Hercules*, though at laſt he was indebted to her for his Immortality; for *Pallas* brought him in his Infancy to *Jupiter*, who put him to *Juno*'s

Breaſt to ſuck while ſhe was aſleep; but the Goddeſs, waking ſuddenly, the Milk ran from her Breaſt, and falling ſuddenly upon the Sky, cauſed the Galaxy or milky Way, which runs in the Heavens from North to South; ſome Drops falling upon the Earth cauſed the Lillies to become white, which before were yellow.

(65.) *Jupiter*, great King or Maſter of all the Deities; Son of *Saturn* and *Rhea* or *Veſta*. His Exploits cannot be inſerted here: It is enough to ſay, (1.) He firſt defeated the *Titans*, who warred againſt his Father *Saturn*, and then afterwards dethroned his Father. (2.) He had ſeveral Wives beſides *Juno*, viz. *Metis*, whom he devoured when big with Child, and he himſelf became pregnant with *Minerva*, who ſprang out of his Head full grown. (3.) He turned himſelf into all Manner of Shapes and Forms to betray the Honour and Chaſtity of the Nymphs and Goddeſſes. (4.) He deflowered *Caliſto* in the Form of the Goddeſs of Chaſtity, and then turned her into a Bear, and made her afterwards a Conſtellation of that Name. (5.) Alſo his Siſter *Juno*, in the Form of a Cuckoo, by whom he had *Hebe*, *Mars*, *Vulcan*, and *Lucina*. (6.) In Form of a white Bull, he carried off *Europa* into *Crete*; ſurprized *Aſteria* in the Shape of an Eagle; *Ægina* in the Similitude of a lambent Fire; *Clytoris* in the Form of an Ant; *Amphytrion* in the Form of her own Huſband; and even *Danæ*, though her Father built her a Tower of Braſs to ſecure her, he deſcended in a golden Shower, baffled the Keepers, and took her. (7.) He turned *Lycaon* into a Wolf, for ſerving up the Fleſh of one of his Domeſtics at Table, while *Jove* was preſent, and conſumed his Palace with Lightening. (8.) He alſo deluded *Semele*, *Io*, and many others; but worſt of all, (9.) He one Day ſeized the beautiful Boy *Ganymede*, Son of *Tros*, and made him both his *Catamite* and Cup-bearer. (10.) The Reign of *Jupiter* not being ſo regular and mild as that of *Saturn*'s, it was now called the *Silver*, inſtead of the *Golden Age*. (11.) *Jupiter* is repreſented various Ways, but in general like a grave, majeſtic Man, ſitting on a Throne, holding Thunder and an Eagle in his right Hand, and Darts or Victory in his left; at other Times the Eagle is at his Feet.

(66.) *Latona*,

(66.) *Latona*, Mother of *Apollo*, and his twin Siſter *Diana*.

(67.) *Lethe*, a River of Forgetfulneſs.

(68.) *Lucina*, one of the Names of *Juno*, and *Diana*.

(69.) *Mars*, the God of War. *Juno* bare him alone, as *Jupiter* bare *Minerva*, and in Oppoſition to her Huſband, called him the God of War or Revenge. She appointed *Thero* or Fierceneſs to nurſe him, and ſent him afterwards to the barbarous *Scythians* for his Education. (2.) *Mars* is alſo called *Quirimus* and *Gradivus*. (3.) *Mars* is often repreſented in a ſtanding Attitude, with Breaſt-plate and Helmet, a Sword or Weapon in his right Hand, and a Shield in his left; but in general he is repreſented with a fiery Aſpect, completely armed, drawn by raging Horſes, extending his Spear, and in the other Hand graſping a Sword, embrued with Blood, having *Diſcord*, *Clamour*, *Terror*, and *Fear* for his Attendants.

(70.) *Meduſa*, raviſhed by *Neptune*, and her Hair turned into Snakes by *Minerva*, and afterwards had her Head cut off by *Perſeus*.

(71.) *Mercury*, (called alſo *Hermes*) the Son of *Jupiter* and *Maia*; he is eſteemed as a Demi-Deity, and called the Meſſenger of the Gods, or Meſſenger of Speed. He is ſaid to preſide over Eloquence, Sprightlineſs, and Activity. (2.) It is on this Account that he is called ſometimes the Father of Theft and Deceit, being capable of gaining his Deſign by cunning Tricks and deceitful Speeches. (3.) This he ſhewed very early; for *Vulcan* being fond of him in his Infancy, one Day dandled the little Brat in his Arms; *Mercury*, in Return for his Love, ſtole away all his Tools. (4.) He alſo ſtole the Ceſtus of *Venus*, and the Scepter of *Jupiter*; but attempting to ſteal his Thunderbolts, he burnt his Fingers ſeverely. (5.) After this he ſtole the Cows of *Admetus*. (6.) But he is in general called the God of Rhetoric, Eloquence and Oratory. He was alſo famous for his Skill in Muſic, and firſt taught the Art of Letters, and therefore was often called to decide Quarrels among the Gods as Arbitrator. (7.) He is repreſented ſtanding on his right Leg, his left Hand pointing

upwards, and in his right Hand a winged *Caduceus*, and Wings upon his Head and his Heels.

(72.) *Midas*, King of *Phrygia*, who gave falſe Judgment, by praiſing *Pan*'s pretended Harmony before *Apollo*'s, was rewarded by having Aſſes Ears placed upon his Head.

(73.) *Minerva* (called alſo *Pallas*) the Goddeſs of War, Wiſdom and Sciences. She was born full grown in the Iſle of *Rhodes*, by Means of *Jupiter*'s violently ſtriking his own Head, and out ſhe ſprang; on which Account ſhe is called *Athena*, becauſe ſhe never ſucked the Breaſt; and by others *Ametroſs*, as having no Mother. She excelled all others in the Art of Spinning, and therefore ſhe turned *Arachne*, the Daughter of *Idmon*, into a Spider, becauſe ſhe challenged her at this Art. *Minerva* is repreſented various Ways, but more fully in a fine Poſture or ſtanding Attitude, a ſteady, yet ſmiling Countenance, is completely armed, has a gold Breaſt-plate, a Spear in her right Hand, and a frightful Ægis in her left, with the Head of *Meduſa*, accompanied with Snakes. Sometimes ſhe has an Owl and Cock at her Feet or in her Hand; the former an Emblem of Wiſdom, and the latter denotes War.

(74.) *Minos*, one of the Judges of Hell.

(75.) *Momus*, the God of Pleaſantry and Humour. He was ſuppoſed the Son of *Somnus* and *Nox*. He is called *Jupiter*'s Fool or Jeſter, and was often ſent for to make the Gods merry. A Story is related of him as follows: *Neptune*, *Minerva*, and *Vulcan*, one Day challenged each other for their Skill, and left it to *Momus* to decide. *Neptune* made a Bull, but he found Fault with it, becauſe his Horns were not ſet before his Eyes that he might puſh with greater Certainty. *Minerva* made an immoveable Houſe, which he diſliked, becauſe it could not be moved in caſe of bad Neighbours; and *Vulcan* made a Man which he highly condemned, becauſe he had not a Window in his Breaſt, to ſee what was coming upon, or might happen to him.

(76.) *Morpheus*, the God of Sleep and Dreams: He is repreſented by the Figure of a Boy aſleep, with one Arm or Elbow, leaning on a black Marble, (ſignifying Night)

Night) and with a Bundle of Poppies under the other Arm.

(77.) *Muſes*, the Daughters of *Jupiter* and *Mnemoſyne*. (1.) *Calliope* preſided over Rhetoric and vocal Muſic. (2.) *Clio*, the Muſe of Hiſtory and Narrations. (3.) *Erato*, the Muſe of Poetry, and Inventreſs of Dancing. (4.) *Thalia* preſided over Comedy, or whatever was merry. (5.) *Euterpe* over Tragedy. (6.) *Melpomene* over Lyric and Epic Poetry, and Dignity of Style. (7.) *Terpſichore*, called Protectreſs of Muſic, Inventreſs of the Flute, and preſided alſo over Logic. (8.) *Polyhymnia* over Oratory, Poetry, and fine Geſture; and, (9.) *Urania*, the Muſe who preſided over all celeſtial Subjects, as Prayer, Praiſes, and divine Muſic.

(78.) *Neiades*, the Nymphs of Brooks and Rivers.

(79.) *Nemeſis*, Daughter of *Jupiter* and Neceſſity; one of the Goddeſſes of Juſtice, having a Pair of Scales in one Hand, and a Whip in the other.

(80.) *Neptune*, the moſt noted Son of *Saturn* and *Ops* or *Veſta*, and the Brother of *Jupiter*. His favourite Wife was *Amphitrite*, who was gained to him by the Interceſſion of the Dolphin, which *Neptune* afterwards placed among the Stars. (2.) He had two other Wives, *Salacia*, from the Salt Water, and *Venelia*, the Ebbing and Flowing of the Tides. (3.) He is called God of the Sea or Ocean. (4.) He changed *Theophane* into an Ewe, and himſelf into a Ram, and begat the golden fleeced Ram. (5.) He is repreſented with dark Hair; his Garment a Sea-green, riding in a large Shell, drawn by Sea-Horſes, with a Trident in his Hand, attended by a long Train of Sea-Goddeſſes, Tritons, and Sea-Nymphs.

(81.) *Nereus*, Son of *Oceanus*, and Maſter of the *Ægean* Sea.

(82.) *Nox*, the moſt ancient of all the Deities. She had a numerous Offspring of Gods and Goddeſſes. She married *Erebus*, by whom ſhe had *Labour*, *Emulation*, *Deceit*, *Fear*, *Darkneſs*, *Complaint*, *Miſery*, *Partiality*, *Care*, *Diſappointment*, *Diſeaſe*, *War*, *Hunger*, *Want*, &c.

(83.) *Oceanus*, the Son of *Cælus* and *Terra*.

(84.) *Ops*, one of the Names of *Cybele*.

(85.) *Oreades*,

(85.) *Oreades*, Nymphs of the Mountains.

(86.) *Orion*, the Son or Production of *Jupiter*, *Neptune*, and *Mercury*. The Story is as follows: They all took a Tour to *Tanagara*, a City of *Bæotia*, where they were well entertained by the hoſpitable *Hyricus*, in Return for which they deſired him to aſk what he pleaſed, and it ſhould be granted. Old *Hyricus* requeſted he might have a Son in his old Age; accordingly, they bade him bring an Ox-Hide, which was done; and after they had made Urine (or piſs'd) in it, they bade him bury it ten Months, and then take it up; which he did, and upon taking it up found a fine Boy, which he named *Urion*, from their Urine; but it being more decent, he was afterwards called *Orion*. He was killed by *Diana* in hunting, and afterwards tranſlated to a Conſtellation, called *Orion*, which uſed to be remarkable for producing Rain and Storms, when he roſe acronically.

(87.) *Orpheus*, the Son of *Phœbus*, by the Muſe *Calliope*. He was ſo remarkably ſkilled in the Performance of Muſic, that he went down to Hell to fetch his beloved Wife *Eurydice*, and he effected his Deſign; for he ſo charmed old *Pluto* and *Proſerpine* with his Harmony, that they had no Power to hold her. Some ſay he was tore to Pieces by *Bacchus*; others that he was tranſformed into a Swan; be this as it will, his Harp was tranſlated to Heaven, and formed a Conſtellation. He is often repreſented by a Youth, with Life and Sprightlineſs, playing on a Lyre or Siſtrum, with a tame Lion by him, to ſhew the Power and Efficacy of Muſic.

(88.) *Orus*, an *Egyptian* Deity, Son of *Oſiris* and *Iſis*, and is generally repreſented ſtanding between them, like a *Cupid* or winged Boy.

(89.) *Oſiris*, an *Egyptian* Deity, Brother and Huſband to *Iſis*, and Brother to *Typhon*.

(90.) *Pales*, the Goddeſs of Shepherds.

(91.) *Pallas*. See *Minerva*.

(92.) *Pan*, the God of Shepherds and Hunters, becauſe he preſided over Flocks and Herds. He is eſteemed as an *Egyptian* Deity, and is ſaid to be the Son of *Penelope*. He is repreſented with a ruddy Countenance, two ſhort Horns on his Head, a long thick Beard, cloathed

cloathed with a ſpotted Skin, crowned with Pine, having a Shepherd's Crook in one Hand, and unequal Reeds or Pipes in the other, with a Noſe, Feet, and Tail like a Goat.

(93.) *Paris*, youngeſt Son to *Priamus*, King of *Troy*.

(94.) *Pandora*, the firſt Woman formed by *Vulcan*. All the Gods and Goddeſſes preſented her with ſomething to add to her Perfection, *Pallas* gave her Wiſdom, *Venus* Beauty, *Mercury* Eloquence, *Apollo* Muſic, *Juno* Riches; but *Jupiter* thought ſhe was not yet a complete Woman, therefore he preſented her with an encloſed Box full of *Diſcord*, *Envy*, *Calumny*, *Diſeaſes*, *Age*, *War*, *Peſtilence*, and *Famine*; but her Huſband *Epimetheus* opened it, and let out all theſe Plagues among Mankind; nothing remained but only *Hope* at the Bottom.

(95.) *Pegaſus*, a winged Horſe, produced by the Blood which fell from *Meduſa*'s Head.

(96.) *Perſeus*, the Son of *Jupiter* and *Danae*. He was pretty famous for Arts and Literature, and alſo heroic Actions. He cut off *Meduſa*'s Head; then he mounted *Pegaſus*, and delivered *Andromeda*, the Daughter of *Cepheus*, from an horrible Sea-Monſter, and afterwards he was placed among the Stars.

(97.) *Phœbus*, one of the Names of *Apollo*.

(98.) *Phaeton* was the Son of *Apollo*, by the Nymph *Clymene*: He was from his Infancy of an aſpiring Diſpoſition, and ſo remarkably conceited, that he undertook every Thing with a ſure Confidence of performing it; and though he had been often reproved for it, yet he could not be diſſuaded from every Attempt; but the moſt remarkable of all is this: He being accuſed by *Epaphus* for being a Baſtard, told his Father *Apollo*, and appeared uneaſy at the Reproach: *Apollo*, to appeaſe his fiery and hot Diſpoſition, ſoothed him, by telling him that whatever he aſked of him it ſhould be granted; *Phaeton* then requeſted that he might drive the Chariot of the Sun round the Globe for one Day only: *Apollo*, ſorry he had made ſuch a Promiſe, laboured to convince him of the Danger, and got ſeveral others to tell him his Inability of performing it ſo young as he was, and with ſuch furious and ungovernable Horſes: But *Phaeton* perſiſting in his Obſtinacy, and *Apollo* not being able

able to get off from ſo ſtrict and affirmative a Promiſe, ſubmitted to the giddy conceited Youth; but no ſooner did he mount the Chariot, than he ſaw the Folly of his Arrogance and Ambition, for the Horſes immediately ran heady and furiouſly along, nor could he, with all his Pride, command their Reins, ſo that they flew here and there at Random, and had like to ſet the World on Fire, had not *Jupiter* interpoſed, and with his Thunderbolts ſtruck him headlong into the River *Eridanus*, now called *Po*. His three Siſters, *Phœbe*, *Lampetia*, and *Phaethuſa* lamented him ſo much on the Banks, that they were at laſt changed into the black Poplar Tree. *

(99.) *Phlegethon*, one of the ſulphurous Rivers of Hell.

(100.) *Pleiades*, the ſeventh Daughter of *Atlas* by *Pleione*; their Names are *Maia*, *Electra*, *Halcyone*, *Celæna*, *Aſterope*, *Taygete*, and *Merope*; *Jove* tranſlated them into a Conſtellation, commonly called the ſeven Stars.

(101.) *Pluto*, Son of *Saturn* and *Ops*, and King or Ruler of Hell and all the infernal Regions. He is repreſented in a Chair, drawn by four black Horſes, with a ghoſtly Wand in one Hand, and ſometimes a Sceptre in the other.

(102.) *Pomona*, the Goddeſs of Orchards and Fruit-Trees, but particularly of Apples.

(103.) *Prometheus*, the Son of *Iapetus*. He was a great Favourite of *Pallas*; but put ſuch a Trick upon *Jupiter*, that he reſented it ever after; and therefore ſent *Mercury* and *Vulcan* to ſeize and carry him to Mount *Caucaſus*, and chain him there to a Rock, and ſet a Vulture to prey upon his Liver, which *Jupiter* moſt barbarouſly renewed every Day in Proportion to what the Vulture devoured: But *Hercules* killed the Vulture and releaſed him.

(104.) *Proſerpine*, the Daughter of *Jupiter* and *Ceres*,

* Of all the Tales in the Heathen Mythology, none is a better Leſſon for Youth than that of *Phaeton*'s Conceit and Headineſs. For hereby they are taught not to aſſume any Thing beyond their little Spheres; but conſtantly and readily obey their Parents, and be ready to receive and follow all good Advice, leſt they come to a ſudden and untimely End.

raviſhed

raviſhed by *Jupiter*, in Form of a Dragon. She was married to *Pluto*.

(105.) *Proteus*, the Son of *Neptune*, by the Nymph *Phœnice*, and Keeper of the Sea-Calves. He had Power to turn himſelf into all Manner of Shapes.

(106.) *Pygmalion* fell in Love with an Image of his own making, and *Venus* changed her into a Woman for him, and he married her.

(107.) *Python*, an enormous Serpent, ſent by *Juno* to devour *Latona*, but *Apollo* killed it.

(108.) *Rhadamanthus*, one of the inferior Judges of Hell.

(109.) *Rhea*, one of the Names of *Cybele*.

(110.) *Saturn*, the youngeſt Son of *Cælus* and *Terra*. He was perſuaded by his Mother to exclude his elder Brother *Titan*, but on Condition of his reigning in *Titan*'s Stead, he engaged to devour all his Male Children, that they ſhould not inherit after him; but *Veſta* hid one Boy and preſerved him. *Saturn* heard of it, and demanded the Boy, but his Wife, inſtead of the Child, gave him a Stone, which he greedily ſwallowed, and ſhe, for the Honour, named the Stone *Ab-addir*. (2.) The Reign of *Saturn* was ſo mild and happy, that it was called the *golden Age*. (3.) *Saturn* is generally repreſented like an old Man, bare and bald-headed, full of Age and Infirmities; in his right Hand is placed either a Sickle, Scythe or Key, and a Serpent in his left, or twining in a circular Form, biting his own Tail.

(111.) *Satyrs*, the Attendants of *Bacchus*, who reſided in Woods and Foreſts; they were very luſtful and wanton, and delighted to defile the Nymphs. They had deformed Heads, ſhort Horns, hairy Bodies, crooked Hands, Legs and Feet like Goats, and Tails like Horſes.

(112.) *Semele*, Daughter of *Cadmus*, and one of *Jupiter*'s Miſtreſſes, who vainly deſired the God to embrace her in full Majeſty, as he did *Juno: Jupiter* with Reluctance granted her Requeſt, and ſhe, for her Folly, was conſumed in the Effulgence of his Light, not being able to withſtand the dazzling Luſtre. This was a deſigned Trick of *Juno* to deſtroy her.

(113.) *Silenus*,

(113.) *Silenus*, the God of Drinking. He was Preceptor to *Bacchus*, and is repreſented or depicted as a ſhort, corpulent old Man, with a red Face, and prominent Forehead, a flat Noſe, and large Ears; ſeated upon an Aſs, and yet ſupporting himſelf with a long Stick or Staff in one Hand, and in the other a *Cantharus* or Pitcher, whoſe Handle ſeems to be worn out by frequent Uſe.

(114.) *Syſiphus*. Authors differ about him, but it is ſaid that he was a *Trojan* Secretary, and very unfaithful to his Truſt: Others ſay he was a noted Robber. However, all agree that his Puniſhment was this: He was condemned to roll a great Stone to the Top of a very high Hill, which no ſooner came near the Summit but down it went again.—From hence comes the common Saying, for Perſons who are in ſuch conſtant Toil, Labour, and Slavery, that they, without a View of Eaſe and Freedom, are like *Syſiphus*.

(115.) *Styx*, one of the Rivers of Hell, noted for being as much too cold as *Phlegethon* is too hot. It is that River which Souls are ferry'd over by old *Charon* into the *Elyſian* Fields.

(116.) *Sylvanus*, one of the Gods of the Groves.

(117.) *Syrens*, Daughters of *Achelous*, ſo noted for their harmonious Voices, that whoever heard them were ſure to be decoyed and killed by them. Their upper Parts are like a Woman, and their lower Parts like a Fiſh; and from hence comes the idle Tale of Merrimaids, or rather Mermaids, *viz.* Maids of the Water.

(118.) *Tantalus* entertained the Gods with the Fleſh of his own Son, for which he was ſent to *Tartarus*, and there afflicted with eternal Hunger and Thirſt; having both Water and the beſt Meats and Fruits within his Reach, and yet not able to come at one Bit or one Drop.

(119.) *Tartarus*, Hell, or the dark and diſmal Receſſes of the infernal Regions, the Place for wicked Souls, ſurrounded by the flaming Waters of *Phlegethon*, and committed to the Care of the three *Furies*, or avengeful Siſters, *Alecto*, *Megæra*, and *Tiſiphone*.

(120.) *Thamyris*, for challenging the Muſes in Muſic, *&c.* was ſtruck blind by *Jupiter*, and ſent to *Tartarus*.

(121.) *Themis*,

(121.) *Themis*, the Goddeſs of Laws and Ceremonies.

(122.) *Tereus* raviſhed *Philomela*, and afterwards was transformed into a *Lapwing*.

(123.) *Terra*, the Mother and Wife of *Cælus*.

(124.) *Theophane*, a beautiful Virgin, transformed by *Neptune* into an Ewe, and he, in the Form of a Ram, begat the golden fleeced Ram of her.

(125.) *Theſeus*, Son of *Ægeas*.

(126.) *Thetis*, Mother of *Achilles*; ſhe dipped him in the River *Styx* to make him invulnerable, and then committed him to the Care of the Centaur *Chiron*, to inſtruct him in War.

(127.) *Tireſias*, deprived of his Sight by *Minerva*, becauſe he happened to ſee her bathing in a Fountain.

(128.) *Tiſiphone*, one of the Furies. Being rejected by *Cythæron*, ſhe killed him by throwing one of her Snakes round his Body.

(129.) *Titans*, monſtrous Giants, who ſprang from the Blood of *Saturn*'s Wound when caſtrated by his Son *Jupiter*. *Jupiter*, for this Act of unnatural Diſobedience, was perpetually harraſſed by the *Titans*, who waged War continually with him; and had not *Apollo*, *Juno*, *Mercury*, and ſeveral other of the Gods, but particularly *Hercules*, aſſiſted, they had dethroned *Jupiter*; for *Typhon*, the moſt monſtrous of all the Giants, took *Jupiter* Priſoner, forced his own Sickle or Scymetar out of his Hand, and carried him on his Back to *Cilicia*, and bound him in a Cave; but he was reſcued, and *Typhon* fled to *Sicily*, where he was covered with a huge Mountain, which ever ſince vomits Fire, and is ſuppoſed to be *Ætna*.

(130.) *Tityus*, Son of *Jupiter* and *Elara*. He attempted the Chaſtity of *Diana* and *Latona*; and *Apollo* killed him, and ſent him to *Tartarus*, where he was chained down flat on his Back, having a Vulture preying on his Liver. It is reported he was of ſuch an enormous Size as to cover nine Acres of Ground.

(131.) *Triton*, Son of *Neptune* by *Amphytrite*; he uſed to ſteal the Cattle from the *Tanagrian* Fields, and deſtroy ſmall Veſſels on the Coaſts; but the Inhabitants made him drunk at an Invitation, and then cut off his Head. *Triton* is repreſented with a large Mouth, bluiſh Eyes,

and

and ſhort matted Hair, his Shoulders covered with Purple, variegated with Scales: From the Waiſt upwards he is like a Man; his Feet like a Horſe, and his lower Parts like a Dolphin, with a forked Tail, and ſometimes drawn in a Car by Horſes of a Sky Colour, having in his Hand a Shell Trumpet.

(132.) *Typhon* or *Typhæus*, the moſt noted of the *Titans* or Giants, ſaid to have an hundred Dragons Heads, Eyes of Fire, and uttering diſmal Sounds. See *Titans*.

(133.) *Venus*, the Goddeſs of Love and Beauty. She ſprang from the Fermentation of Froth upon *Saturn*'s Caſtration, which was thrown into the Sea, from whence ſhe alſo is called *Aphodite*. She was ſo exceeding beautiful, that at the Aſſembly of the Gods, all had a Deſire to marry her; however, *Vulcan* at laſt gave her ſome Poppies, which threw her into a Sleep, and then took Poſſeſſion of her, but ſhe was even with him, afterwards having Amours with *Apollo*, *Mars*, *Mercury*, and *Neptune*; but her deareſt Favourite was *Adonis*. She had many Names, ſuch as *Marina*, from her being born in the Sea; *Melanis*, from her nocturnal Amours; alſo *Meretrix*, *Genetrix*, &c. She had Temples almoſt in every Place. She is repreſented in various Attitudes, but generally clothed with Purple, glittering Gems on her Head, ſitting in an Ivory Car, drawn by Swans or Doves; at other Times in a ſtanding Poſture, a very ſmiling and engaging Countenance; attended by Doves, but ſeldom without her Son *Cupid* by her Side.

(134.) *Veſta* the Elder, called alſo *Cybele*, the Daughter of *Cælus* and *Terra*. As *Veſta*, ſhe is repreſented ſitting, with a Sphere in one Hand, and a lighted Torch in another. As *Cybele*, ſhe is repreſented in a Phaeton or lofty Chariot, drawn by Lions, crowned with Towers, with a Key in one Hand extended.

(135.) *Veſta* the Younger, the Goddeſs of Fire, Daughter of *Saturn* by the Elder *Veſta*, and Siſter to *Jupiter*, *Pluto*, *Neptune*, *Juno* and *Ceres*.

(136.) *Vulcan*, the God of Fire, Son of *Jupiter* and *Juno*, but others ſay of *Juno* only; however, it is agreed that he was ſo deformed, that he was caſt out of Heaven upon the Iſle *Lemnos*, and in his Fall had his Thigh broke, which rendered him yet more and more ugly.

ugly. But to repair ſo great a Loſs, he ſat up a Forge, taught the Art of working in all Manner of Metals. His Journeymen or Aſſiſtants were the *Cyclops*, and the principal Works he performed were as follows. He made Thunderbolts for *Jupiter* whenever he wanted. He alſo made *Neptune*'s Trident; the invincible Helmet for *Pluto*; a golden Crown for *Bacchus*; a Chariot for the *Sun* and *Mars*; the divine Armour of *Achilles*; the invincible Armour of *Æneas*: But to ſhew his Skill, he made his Mother *Juno* a Chair of Gold, which was ſo managed by hidden Springs, that when ſhe ſat in it they cloſed her ſo faſt that ſhe could not move till ſomebody came to her Aſſiſtance. (*z.*) He alſo has ſeveral other Names, *viz. Lemnius*, *Mulcifer*, or *Mulciber*. He was very jealous of *Venus*, and that not without Cauſe; for *Mars* was one of her chief Gallants; but the *Sun* watched all their Motions. *Mars* perceiving this, ſet the Boy *Alectryon*, or *Gallus*, to watch all Night, and give him Notice before *Apollo* aroſe in the Morning; but unlucky for them, their little Watchman fell aſleep, and the *Sun* in the Morning ſaw *Mars* and *Venus* in an Amour, and told *Vulcan*, who immediately made him a Net and caught them both in it, and there kept them ſome Time, and expoſed them to all the Gods and Goddeſſes moſt ſhamefully. *Mars*, to be revenged on *Alectryon*, turned him into a Cock, who, ever ſince, gives Notice, by his Crowing, of the Approach of *Apollo*, *viz.* of the *Sun*'s riſing. *Vulcan* is generally depicted like a ſqualid, lame, and deformed Man, working at an Anvil, and attended by the *Cyclops*, his Journeymen.

Thus, *Tyro*, have I given you a conciſe Account of the Heathen *Mythology*, which, tho' imperfect or deficient, yet will help you very much to underſtand all *poetical* and other Authors, who have made, and do make or draw Alluſions from this fabulous Hiſtory.

Tyr. I humbly thank you, kind *Philomathes*. It is prolix enough for me, and better than if it had been much longer.

THE

THE

YOUNG MAN's Book of Knowledge, &c.

PART III.

OF NATURAL PHILOSOPHY, &c.

SECT. I.

Tyro. WHAT is *Philoſophy?*

Phil. Philoſophy is the Knowledge or Study of Nature and Morality, founded on the ſelf-evident Principles of Truth and right Reaſon.

Tyr. What does it principally teach us?

Phil. Philoſophy teaches us to ſearch after Truth itſelf, has its Rules, Laws, or Axioms built upon right Reaſon, and therefore inſtructs us in the Knowledge of the *Nature*, *Cauſes*, *Properties*, and *Effects* of Things in general.

Tyr. What do you mean by the *Nature* of Things?

Phil. That eſtabliſhed Order or Courſe; that eſſential Property, by which Things are diſtinguiſhed from each other: Or it is a Series of ſecond Cauſes, which the all-wiſe and eternal Creator has impreſſed upon Matter in all Bodies and Subſtances whatever.

Tyr. Be ſo kind as to explain what you mean by ſecondary, or ſecond Cauſes, for I do not apprehend it. Is not a Perſon that does a Thing, or cauſes it to be done, the real Cauſe thereof?

Phil. In many Caſes it may with Propriety of Language be ſaid ſo; but philoſophically it is not ſo; nor will the Laws of Philoſophy allow but one Cauſe, the Reſt, or Reſult of the firſt, being only Effects thereof.

Tyr.

Tyr. I am not quite clear in this yet.--Suppoſe you were very cold, and I kindle you a Fire, by which you are comforted; or in any Diſtreſs, of Debt or Danger, and I deliver you, am not I the Cauſe of all this?

Phil. I told you before, that in Language you may be ſaid to be ſo; it would look pedantic to expreſs it otherwiſe, and my Thanks are certainly due to you, at all Times and in all Places: But notwithſtanding this, as you were not the *primary* Cauſe of theſe Things, I ſhould only call you a ſecondary Cauſe, or an Effect of the *firſt moving* Cauſe.

Tyr. Why ſo?

Phil. Becauſe you could not have kindled the Fire without ſuch Matter ſuited thereto, which cauſes that Senſation in us, *&c.* Again, you cannot pretend to be the real Cauſe of delivering me from Debt or Danger, till you have both Power and Inclination; for had you Ability, you might want Inclination; had you Inclination, if you had not Ability you could not execute your Deſign without ſome further Aſſiſtance, which may be called a third Cauſe or Effect, and ſo on to ten thouſand. Theſe, however, depending on each other for Power, Ability, Intereſt, Diſpoſition, *&c.* are all called ſecond Cauſes; but even you, who were the firſt of theſe ſecondary Cauſes, neither did, nor can give yourſelf ſuch Power, Ability, Diſpoſition or Inclination, therefore you are only a ſecondary Cauſe in all the Actions, and are, with me, indebted to God, the *primary* Cauſe; but with this Difference, that you are indebted for that Power and Inclination, but I am (by the Laws of *Philoſophy* and right Reaſon) indebted to both; to *Him*, as the real Cauſe, and to *You*, as the Inſtrument or Effect thereof.

Thus, you ſee, every Thing, or all created Beings are but Effects or ſecondary Cauſes, though the Word is uſed with Propriety without ſuch Diſtinction. Thus we ſay, the Sun is the *Cauſe* of Vapours; Vapours the *Cauſe* of Clouds; Clouds of Rain; Rain of Springs, Rivers, *&c.*

Tyr. I thank you, Sir, I underſtand you quite well; but pray what do you mean by the *Property* or *Properties* of Bodies or Beings of any Sort?

Phil.

Phil. The *Properties* of Bodies are thoſe Qualities, Productions, and Operations peculiar to each Body, and by which one is more particularly diſtinguiſhed from another: Thus it is the Property of *God*, the *primary* Cauſe, to be no other than *good*, *merciful*, *unerring*, &c. But of the *Devil*, or damned Spirits, to be always bad, unmerciful, implacable, *&c.* It is alſo the Property of *Man* to *think*, to *reflect*, to *laugh*, to *grieve*, &c. The Property of Glaſs to be tranſparent and brittle; of Fire to burn or deſtroy; of the Wind to be cool and inviſible, *&c.*

Tyr. Pray what is an Effect? Is it the ſame as a ſecondary Cauſe, for you ſeem to have made very little or no Diſtinction?

Phil. In reſpect of the *Primary* Cauſe, all other may be called Effects; but to ſpeak of the Action of ſecondary Cauſes, they all have their Effects alſo. Thus congealed Water or Ice, is the Effect of a ſevere cold Air; a *Thaw* the Effects of the Air being ſo warm as to melt it; a good Harveſt the Effect of Induſtry, and ſeaſonable Weather; a miſerable Life and Death the Effects of Vice; a comfortable Life, the Effects of Eaſe and Plenty; and a bleſſed and happy End, the Effects of Virtue, Content and Reſignation, *&c.*

SECT. II.

Contains a farther Definition of Philoſophy, with certain Rules of philoſophizing.

Tyr. What is farther neceſſary to be known to attain to the Knowledge of Natural Philoſophy?

Phil. There are certain Axioms, Rules, or ſelf-evident Principles upon which this Science depends; and of which you may ſoon make yourſelf Maſter, by reading them a few Times over; and if you obſerve them well, you cannot be led into Error by them, becauſe they are ſelf-evident Truths.

Tyr. Pleaſe to let me hear them, and if there be any Thing difficult in them, pleaſe to define them, becauſe I may not immediately apprehend them.

Phil. I will.

AXIOM

AXIOM or RULE I.

Nothing *has no Properties*; *that is*, Nothing, Non-entity, *or* Negation *of* Being *have no Exiſtence, therefore can have no Property.*

AXIOM II.

Something *doth exiſt*; *then every real Thing has or is endued with ſome Property or Properties, becauſe it exiſts.*

AXIOM III.

There is no Medium between Exiſtence *and* Non-Exiſtence, *between* Something *and* Nothing; *for a Thing muſt be or not be*; *and it is impoſſible it ſhould be and not be, at one and the ſame Time.*

AXIOM IV.

Nothing *can never be made into* Something; *that is* Something *never can be produced out of* Nothing; *or* Nothing *has no Properties, by* Axiom I.

AXIOM V.

Something *can never be reduced to* Nothing; *that is, no Subſtance or Being can be really annihilated or reduced to a State of Negation. This is very clear from* Axiom I. *and* III.

AXIOM VI.

That *which exiſts of itſelf, is independent, and conſequently all other Beings or Subſtances are dependent thereupon, and are but Effects thereof*.*

* The Athieſt, Fataliſts and Free-Thinkers are very fond to keep up to the ſtrict Rules of this, and Axiom 4 and 5, and draw curious and unneceſſary Arguments from them, in order to overturn or leſſen every Thing tending to the Belief of the Self-Exiſtence of God and weaken the Syſtem of revealed Religion. The Fataliſts call God's Omnipotency in Queſtion, and ſay, Matter is eternal, according to Axiom 1ſt and 4th; but admit the Being of God cannot be ſelf-evidently proved by the Laws of Philoſophy. What then? Muſt we deny every Thing that we cannot comprehend?—We know that there is a Circle and a Square, but the real and true Proportion to each other is not known, nay, is in itſelf contradictory, and ſo are many other Things in Nature. If then we cannot comprehend this, and many other Things that daily preſent themſelves to us; is it not vain to ſearch after thoſe that we never can comprehend? and is it not as equally abſurd to deny their Nature and Exiſtence, becauſe they are far beyond the Reach of Man's ſhallow Capacity?

AXIOM

AXIOM VII.

Whatever is not the real Cauſe of an Effect, can be no other than a ſecondary Cauſe, and as ſuch muſt be dependent, therefore is itſelf no other than an Effect, by Sect. I.

AXIOM VIII.

Every Thing in Nature, after its Creation, would for ever continue in that State and Poſition of itſelf, were it not for ſome Cauſe acting upon it to alter either the State, Condition, or Poſition thereof. Therefore,

AXIOM IX.

Every Change is produced from ſome Cauſe or other.

AXIOM X.

Natural Cauſes produce natural Effects, but they can never of themſelves produce ſupernatural ones; but a ſupernatural Cauſe may produce Effects of every Kind.——

N. B. This may at firſt appear abſurd to a critical and quibbling Philoſopher, but I believe it will not be thought unnatural from the Nature of God and the Law of Nature itſelf.

AXIOM XI.

All and every Change in any Body will always be in Proportion to the Power or Force of the Cauſe acting upon it.

AXIOM XII.

Nature acts conſtantly in an uniform Order to itſelf; doth nothing in vain (by Axiom 10.) *We muſt from hence then aſſign the ſame Reaſon and Cauſes for Heat in Water, as in Fire, and that of Reſpiration in Beaſts and Inſects as in ourſelves,* &c.

N. B. The Qualities and Properties of Bodies are not known by mere *Hypotheſis*, and therefore Recourſe muſt be had to Experiments in many Things, which ſeldom fail to give us a ſenſible Satisfaction. Thoſe, therefore, who have Time and Opportunity, would do well to peruſe Dr. *Derham*, Dr. *Deſaguliers*, Mr. *Rowning*'s, or Mr. *Martin*'s Natural and Experimental Philoſophy.

Do you apprehend theſe Axioms?

Tyr. I think they are very eaſy to be underſtood.

Phil. Then we will proceed to

SECT.

SECT. III.

Of Matter in general, with a ſhort Account of ſome of its moſt material known Properties.

Tyr. What is *Matter?*

Phil. A hard, maſſy, diviſible and moveable Subſtance; the Eſſence or firſt Principle of all natural Things; and from whoſe Arrangements and various Combinations of Particles, ariſe the different Bodies of the Univerſe.

Tyr. Is the intimate, inmoſt or internal Nature of Matter known?

Phil. No, it is not; but ſome Properties belonging thereto are known to us, and it is evident the primary Particles or Atoms of Matter are the ſame in all Bodies.

Tyr. Is Matter *finite* or *infinite?*

Phil. Finite, becauſe it is limited within certain Bounds.

Tyr. How is Matter conſidered in every Body?

Phil. Under the three Denominations of *Length*, *Breadth*, and *Depth*, or *Thickneſs*, the proper Names applicable to Solidity or any ſolid Body.

Tyr. Have all Bodies Properties alike?

Phil. No; but there are certain Properties common to all Bodies; and others have their peculiar Properties.

Tyr. Pray tell me what Properties are common to all Bodies?

Phil. Every Body has at leaſt five common Properties, *viz.* 1. *Extenſion*; for all Bodies fill, or take up ſome certain Space, and may be extended. 2. *Diviſibility*; for all Bodies may be divided into two Parts, thoſe two into four, and thoſe four into eight, *&c. ad infinitum*, or for ever. 3. *Figurability*; for there is no Body or Thing without ſome Shape or Figure. 4. *Mobility*; for all Bodies are capable of being removed into another Situation. And, 5. *Solidity*, for the internal and external Particles of all ſolid Bodies are hard, and act upon one another in ſuch a Manner as to form Figures of various Shapes and Dimenſions.

Tyr. I underſtand you well, Sir; but pleaſe to inform me what Bodies have their peculiar Properties?

Phil. The peculiar Properties belonging to certain Bodies are as follows, *viz.* 1. *Gravity* and *Levity.* 2. *Attraction* and *Electricity.* 3. *Tranſparency* and *Opacity.* 4. *Denſity* and *Rarity.* 5. *Hardneſs* and *Softneſs.* 6. *Rigidity* and *Flexibility.* 7. *Conſiſtence* (or *Thickneſs*) and *Fluidity.* 8. *Heat* and *Cold.* 9. *Humidity* and *Siccity.* 10. *Elaſticity.* 11. *Odours* and *Sapours.* 12. *Light.* 13. *Colours.* and 14. *Sound.* Of theſe in their Order.

SECT. IV.

A Definition of the firſt five common Properties, Extenſion, Diviſibility, &c.

1. *Of* EXTENSION.

Tyr. What is *Extenſion?*

Phil. Extenſion is the Diſtance between the extreme Particles of a Body, taken from any Part of the Surface, to the oppoſite Part thereof; and by this *Extenſion*, the Shape, Size, Dimenſion or Magnitude of any Body is meaſured or known.

Tyr. What do you mean by *Magnitude?*

Phil. It is the ſame as Size or Bulk; but in *Philoſophy* it means the Quantity of Space that any particular Body fills or takes up, which is the juſt and true *Magnitude* or Dimenſions thereof.

2. *Of* DIVISIBILITY.

Tyr. What is *Diviſibility?*

Phil. It is the Act of dividing, or is the Property or Quality of Bodies capable of being divided into Parts, either mentally or actually.

Tyr. I think I underſtand you; you mean no Body or Particle of Matter is ſo ſmall but it may ſtill be divided into two Parts.

Phil. I do; and not only into two Parts, but thoſe two into four; and thoſe four into eight, and ſo on for ever and ever.

Tyr. This is vaſtly ſurpriſing, and one would think incredible.

Phil. It is very evident, that a Particle of Matter, though ever ſo ſmall, is capable of being divided into as many Parts as there are Grains of Sand on the whole Surface

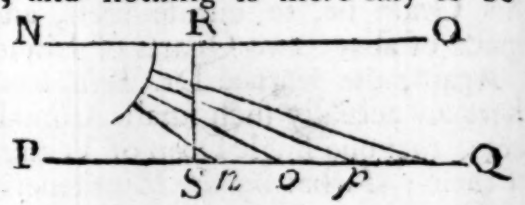
Surface of the Earth; nay, more ſo; for the Grains of Sand are finite, within the Limits of Space and Numbers, but a Grain may be divided infinitely.

Tyr. If the leaſt Particle is capable of infinite Diviſion, what then muſt the largeſt Mountain be?

Phil. You make me ſmile, that you have ſo innocently diſcovered yourſelf to be but a *Tyro:* For if the leaſt Grain of Sand is capable of infinite Diviſion, (as it is) the largeſt Mountain can but be ſo.

Tyr. I aſk Pardon for my Inconſideration; but, however, I ſhould be glad if I could ſee you demonſtrate it, if you poſſibly can.

Phil. That I will, and nothing is more eaſy to be underſtood: For let N O be a right Line, and P Q drawn parallel thereto, and draw alſo R S perpendicular thereto,



which is to repreſent any Particle of Matter to be divided; then draw right Lines from N to *n*, *o*, *p*, Q, which will cut or divide the Line R S into four diſtinct Parts. Now let us ſuppoſe the Line P Q to be infinitely extended; then it is evident, that there might be an infinite Number of Points taken between S and Q: conſequently then, Lines drawn from N to thoſe infinite Points would cut or divide R S infinitely or for ever.

Tyr. I underſtand you now very well, but ſtill I am amazed, and can hardly find myſelf inclined to credit it, or aſſert what I know to be true.

Phil. I don't at all wonder at it; but it will ſurprize you more if I ſhould tell you, that the leaſt Particle of Matter, after it has been thus divided, is capable of ſuch Extenſion as to fill or cover not only the Face of our Globe, but even the Surface of the greateſt Planet in our Syſtem, ſo as no Pore thereof ſhall be void.

Tyr. This is ſo incredible, that I dare ſay you will have few Diſciples to believe it.

Phil. I ſuppoſe ſo; but it is very evident from the very Nature of Matter, and the unaccountable Minuteneſs of its Particles.

Tyr. Can you give me any further Satisfaction on this Head?

Phil. Not demonſtratively, for I think that has been ſufficiently done: But perhaps you may be cured of your firſt Surprize, in ſurprizing you further with more Incredibilities, as you call them.

Tyr. I aſk Pardon, but I hope my Incredulity will not prevent your communicating every uſeful Thing to me.

Phil. Not at all; for I do not wonder at your being ſurprized, and if we conſider the Minuteneſs and Ductility of Matter, it is aſtoniſhing: For Mr. *Boyle* ſays, that one Grain of Vitriol will tinge near 30,000 Grains of Water; how very ſmall then muſt the Particles of this Grain be, to diffuſe itſelf, and ſpread the whole Space of above two Quarts of Liquor.

Again, the learned Dr. *Keill* has demonſtrated, that there are actually ſuch ſmall Animalculas or living Inſects, that one ſingle Drop of Water will cover 100,000 of them; of what *infinite* Minuteneſs muſt the Globules of Blood be, which run or circulate through the Veins of theſe ſmall Creatures, ſince the aforeſaid Gentleman and others have proved, that one of theſe Globules does not exceed the $\frac{1}{100,000,000,000,000,000,000,000,000}$ Part of an Inch. A Number almoſt beyond finite Expreſſion or Conception! *

Tyr. I am obliged to you, and am now ſatisfied concerning the Minuteneſs of the Particles of Matter; but pray what do you mean by *Ductility?*

Phil. Ductility is that Property of Matter belonging to certain Bodies, which is capable of being preſſed or beaten out wider, or drawn out longer; and ſuch is the Nature of Gold, that Mr. *Boyle* ſays, that *one* Grain only may be beaten into a Plate or Leaf containing 50 Square Inches (which is upwards of ſeven Inches every Way in the Leaf) and therefore one Pound will cover a Room 2000 Feet ſquare, according to this Proportion.

Tyr. Surprizing indeed! And pray what is the next Thing or Property you obſerve in Bodies?

Phil. The next Property is commonly called *Solidity.*

* See *Keill*'s Aſtronomy and Natural Philoſophy, *Martin*'s and *Rowning*'s Philoſophy, under the Articles of Diviſibility and Light. Philoſophical Tranſactions, No. 194.

3. *Of*

3. *Of* Solidity.

Tyr. What do you mean by *Solidity?*

Phil. Solidity is that Property by Means of which one Body reſiſts another, and tries to keep its own Station or Situation, though preſſed upon or againſt on all Sides; and in ſome Caſes it is called *Impenetrability*, or impenetrable Solidity.

Tyr. Have all Bodies then this Property?

Phil. Moſt certainly; but why do you aſk ſuch a Queſtion?

Tyr. Becauſe I thought it was only peculiar to ſome Bodies, as Iron, Steel, Stone, Lead, *&c.*

Phil. You make me ſmile again; is it not evident, that Air and Water are very great Reſiſters? And you know very well, that a Drop of Water or Particle of Air placed between any two Bodies will really hinder their Contact or uniting, the ſame as if there were the ſame Quantity of Steel or any hard Body between them.

Tyr. In what does the Shape or Modification of Matter conſiſt?

Phil. In the Form of all the extreme Parts of a Body, on the various Parts of its Surface, by which we determine the Shape or Shapes thereof, and is therefore called *Figurability*, or the Shape, Mode and Form of a Body?

Tyr. How do the inward Parts act upon one another to cauſe ſuch a Form?

Phil. This is not eaſy to account for; but, however, we ſhall ſay more upon this when we come to ſpeak of *Coheſion.*

4. *Of* Mobility.

Tyr. What do you mean by *Mobility!*

Phil. It is that Property of a Body which is capable of Motion, or being moved.

Tyr. What is *Motion?*

Phil. The continual Change of any Body from one Place to another, or that State and Condition which is never at Reſt.

Tyr. What do you mean by *Reſt?*

Phil. Ceſſation of Motion, or the Continuance of a Body in one Place or State.

Tyr. What is the Cauſe of Motion?

Phil. Some external Force or Power, which acts upon the Body at reſt, and drives or moves it out of its Place.

Tyr. What is *abſolute Motion?*

Phil. The real Change or abſolute Place of any moving Body.

Tyr. What is *relative Motion?*

Phil. Is the Change of Place in reſpect of Bodies at reſt, for a Body may be at reſt and yet may be in a relative Motion.

Tyr. How do you make this appear?

Phil. Very eaſy; for when we are in a Ship that is ſailing, though we ſit ſtill, yet we are in Motion, and ſo we are perpetually by the annual and diurnal Motion of the Earth; but this being a Motion which is not felt, is called *inſenſible* or *relative Motion.*

Tyr. I underſtand you well; and pray is there any Thing further to be obſerved concerning the Nature and Effect of Motion?

Phil. Yes, there are three Diviſions, Properties or Affections in Motion, *viz.* 1. Celerity or Velocity; 2. Quantity; and, 3. Direction.

SECT. V.

Of the Celerity, Quantity, and Direction of Motion.

Tyr. What do you mean by *Celerity* or *Velocity?*

Phil. Swiftneſs, or Rapidity; and in Philoſophy it means that Degree of Swiftneſs by which any Body paſſes over a given Space in any certain Time; as ſuppoſe one Body was to paſs over a certain Space, and another was to paſs or run through the ſame in half the Time, then the Celerity of the laſt would double the firſt, *viz.* would move as quick again.

Tyr. I underſtand you; and pray how do you compute the Quantity of Motion?

Phil. By the Quantity of Matter and the Velocity compounded.

Tyr. I don't at preſent underſtand you.

Phil. Obſerve then: Suppoſe one Body to have 4 Parts of Matter and 5 Degrees of Velocity, and another

ther Body has 2 Parts of Matter and 10 Degrees of Velocity, then the Motion of both would be equal, for $4 \times 5 = 20$, and $2 \times 10 = 20$. But if one has 2 Parts of Matter and 4 Degrees of Velocity, and another 6 Parts of Matter and 8 Degrees of Velocity; then the Quantity of Motion in the firſt will be the Quantity of Motion in the ſecond as 8 to 48; for $2 \times 4 = 8$, and $6 \times 8 = 48$.

Tyr. I am obliged to you, kind *Philomathes*; and I can plainly ſee by what you have ſhewn me, that if the Quantity of Matter and Velocities of any two Bodies are equal, their Quantity of Motion will be equal alſo; but if either the Quantity of Matter or Velocity be not equal in each, then their Motion will alſo be unequal.

Phil. You are very right, *Tyro*; but ſtill you muſt remember, that when the Quantities of Matter and the Velocity are in reciprocal or mutual Proportion to each other, then their Motion will be equal: Thus, ſuppoſe $8 : 4 :: 12 : 6$; that is, the Motion of a Body whoſe Quantity is 8, having 6 Degrees of Velocity, is equal to the Motion of another Body whoſe Quantity is 4 with 12 Degrees of Velocity; for $8 \times 6 = 4 \times 12$.

Tyr. I thank you, Sir, for this kind Hint; but pray what do you mean by the *Direction* of Motion?

Phil. Direction is an Impulſe or Force of one Body acting upon another, which is called *ſingle Direction*; but if two Bodies act upon any ſingle Body, it is called *compound* Motion or Direction.

Tyr. Pleaſe to explain this a little further to me.

Phil. Single, *ſimple* or direct Motion, is when a Body is moved out of its Place by a certain Impulſe, and will of itſelf (after ſuch a Force acting upon it) move continually in that Direction in which it firſt ſet out, or was acted upon, except it meets with any Obſtruction.

Tyr. What is *compound* Motion?

Phil. When two or more Bodies act upon any ſingle Body by contrary Directions; for Inſtance, let a String be faſtened to a Ball, and laid on a ſmooth Table, it is evident that if I pull, the Ball will come to me in a direct Line, without it meets with any Obſtruction or

ſecond Force or Impulſe. 2. If another Perſon has a ſecond String faſtened to the Ball, and he ſtands in a right Line with me, and both pull ever ſo eaſy, or ever ſo hard, provided we pull with equal Force, the Body or Ball can never ſtir; but, 3dly, If the other Perſon directs his String in a right Angle to mine, and we pull both equal, the Ball will then paſs in the diagonal Line of a Square, and when it reſts will be equidiſtant from us, and the Velocity will alſo be ſwifter; for the Body being acted upon by two Powers, will paſs through a Line or Space whoſe Square will be equal to the Squares of the Diſtance of both Powers from the Ball. Do you underſtand me?

Tyr. I can't ſay I do.

Phil. Obſerve then: Suppoſe the two Strings fixt as aforeſaid, and we both give a ſudden Pull, Snatch or Impulſe, you with 3 Degrees and I with 4 Degrees of Force, then I ſay, the Ball will fly in a diagonal Line or Direction, will have 5 Degrees of Force, and will paſs over the diagonal Line of the Square in the ſame Time that it would paſs to us by either of our ſingle Powers acting upon it. This is plain (from Figure the 12th) for ſuppoſe the Ball be at A, you act upon it at B with 3 Degrees, I act upon it at C with 4 Degrees of Force, then I ſay the Ball will fly in the diagonal Line A D, with 5 Degrees of Force, and in the ſame Time as it would arrive ſingly from A to B or to C: For $3 \times 3 = 9$, and $4 \times 4 = 16$; now $16 + 9 = 25$, whoſe $\surd$ is $= 5 =$ A D. See Figure 2, in Geometry, Sect. V.

Tyr. Now I underſtand it perfectly well.

Phil. I am glad of it; then we will proceed to give you ſome Account of other Properties reſpecting certain Bodies.

SECT. VI.

Of Gravity and Levity, Attraction and Electricity.

Tyr. What do you mean by *Gravity?*

Phil. Weight; alſo the Power or Property of Bodies by which they naturally deſcend or tend down towards the Center of the Earth, commonly called the Center of *Gravity.*

Tyr.

Tyr. What is the Difference between *Gravity* and *Weight?*

Phil. Some have aſſerted that Weight and Gravity are the ſame, but it is evident that Weight is only the Effect thereof.

Tyr. What are the different Sorts of *Gravity?*

Phil. Gravity is divided into two Sorts, viz. *abſolute*, and *relative* or *ſpecific Gravity.*

Tyr. What is abſolute *Gravity?*

Phil. Abſolute *Gravity* is the whole Force or Power of a Body, whereby it tends towards the Center of the Earth.

Tyr. What is *ſpecific Gravity?*

Phil. Specific Gravity is peculiar to certain Bodies, and diſtinguiſhes them from others when compared together: Or it is frequently taken for or called that Exceſs in one Body compared with the Quantity or Bulk of another.

Tyr. How do you compute or meaſure *Gravity* in different Bodies?

Phil. By the Quantity of Matter contained in them, for the Proportion will always hold good between them.

Tyr. This then is the Reaſon, I ſuppoſe, that heavy Bodies deſcend ſooner or with greater Velocity than light ones.

Phil. Not at all, *Tyro*, for the Property of *Gravity* is ſuch, that its Power or Force acts upon all alike without any Diſtinction of Size or Weight.

Tyr. How can this be? Is it poſſible a Feather ſhould deſcend or fall, 20, 40 or 60 Inches, Feet or Yards, ſo ſoon as a Pound Weight of ſolid Lead, Iron, *&c?*

Phil. Yes, it would, if it were as many Miles, were it not for the Reſiſtance of the Air which acts ſo forcibly upon the Feather and retards its Deſcent; but where there is no Air, that is, if the Air can be exhauſted, the Feather would fall or deſcend in the ſame Time, and with equal Velocity with the Pound Weight, as is evidently proved by the *Air-Pump*, out of which when the Air is exhauſted, both would equally deſcend with incredible Swiftneſs to the Bottom.

Tyr. Then I perceive it is not the Weight of Bodies, but the Power of Attraction over different Bodies; for every Particle of Matter, I ſee, is acted upon by an equal Force of Gravity, only it requires a greater Force of Attraction to move the heavier Body.

Phil. You are right; for all Bodies gravitate towards each other, the Earth gravitates towards the Stone or Weight which is falling or deſcending towards it, as much in Proportion as the Stone to the Earth, only the Bulk and Quantity of Matter is ſo great that we cannot perceive the Motion of one like that of the other.

Tyr. Pray is there any determining the Time of the Deſcent of Bodies falling perpendicularly, or knowing with what Degree of Velocity they fall?

Phil. Yes; for the perpendicular Deſcent is about 15 Feet in a Second of Time, and for all other following Seconds, the Spaces are as the Squares of thoſe Seconds; thus, let the Seconds be 1, 2, 3, 4, *&c.* then their Squares will be 1, 4, 9, 16, *&c.* and the Spaces paſſed through will be 15, 60, 134, 240, *&c.* and the Number of Feet will be as the Multiplication of the odd Numbers, 1, 3, 5, 7, *&c.* that is, 15, 45, 75, 105, *&c.* Or thus; the Spaces Bodies fall through are equal to the Squares of their Times: Thus a Body will fall 4 Times as far the 2d Minute as the 1ſt, becauſe $2\times2=4$, and $3\times3=9$, *&c.* therefore the Diſtance of falling will be 3 Times as far in the 2d Portion of Time as in the 1ſt; 5 Times as far in the 3d, 7 Times as far in the 4th, *&c.*

Tyr. I thank you, Sir; but if this be the Caſe in Bodies deſcending to increaſe, do not Bodies aſcending decreaſe in Proportion?

Phil. No doubt of it, for it is plain the Force is decreaſed as it riſes, and the Law of Gravity perpetually deſtroys the Aſcent: For if a Body be thrown up with any certain Force, ſo as to continue riſing as long again as another Body, it will go 4 Times as high; if it aſcends 3 Times as long, it will go 9 Times as high, *&c.*

2. *Of*

2. *Of* ATTRACTION, COHESION, *and* ELECTRICITY.

Tyr. What do you mean by *Attraction?*

Phil. Attraction and *Gravity* are often expreſſed for one and the ſame Thing, and are uſed indifferently for the ſame Circumſtance in common Expreſſion; but yet there is a ſenſible Difference, for *Gravity* is the natural Tendency of all Bodies towards the Center of the Earth in their Deſcent; but *Attraction* is the Tendency of approaching or drawing near; or it is that Property in Bodies by which they affect, gravitate or tend to each other, and this *Power* or *Property* is called *Attraction.*

Tyr. I do not rightly apprehend this; I wiſh therefore you would explain it further.

Phil. Attraction then is conſidered in two Parts, *viz.* 1. *Attraction* of *Gravity*, and 2. *Attraction* of *Coheſion.*

Tyr. What do you mean by *Attraction* of *Gravity?*

Phil. That Power or Property by which Bodies naturally tend to, or approach one another, by a *centripetal* Force, *viz.* tending to, or being impelled to act towards the Centers of each other.

Tyr. And pray what do you mean by *Attraction* of *Coheſion?*

Phil. I muſt firſt tell you what *Coheſion* is; and that is the Action of Atoms, or primary Corpuſcles of Matter, which act upon each other, ſo as to form viſible or ſenſible Particles; and then by the Law of *Attraction*, theſe Particles do ſo cohere or unite together as to cauſe the different Shapes of all the Maſſes or Lumps of ſolid Bodies, which preſent themſelves to our Sight; but how theſe Atoms or Particles act upon each other ſo as to form ſuch and ſuch a Shape, we know not, becauſe we cannot account for the Actions of the different conſtituent Parts of a Body ſo formed by the *Coheſion* of ſuch Particles *.

* Many are the ſurprizing Effects of the Laws of *Attraction*, and thoſe whoſe Curioſity would lead them further into the Knowledge of theſe Things, may conſult *Martin*'s Phil. Gram. *Rowning*, and other eminent Authors on this Head; but yet, *Tyro*, be not curious, for I tell you that even the great Sir *Iſaac Newton* himſelf, though he makes the Law of *Attraction* and *Gravity* to be the very Baſis of Philoſophy; yet at the ſame Time owns himſelf entirely ignorant of the real Cauſe of either.

Tyr. I am highly obliged to you, kind *Philomathes*, and pray now give me Leave to aſk you what you mean by *Electricity*, and wherein it differs from *Attraction?*

Phil. Electricity is that Virtue, Property, or Faculty of certain Bodies (ſuch as *Amber*, *Glaſs*, *Sealing-Wax*, &c.) that when rubb'd for ſome ſmall Time, will, by the Power of ſuch *Attrition*, *Friction*, or *Rubbing*, attract all light Bodies, ſuch as Hairs, Feathers, *&c.* at a very ſenſible Diſtance, ſo as to cohere, or ſtick to the Body ſo agitated or rubbed, for a certain Space of Time, according to the Power of *Attrition* given to it; and the larger the Body, and the more the Friction, the further will it attract, and the longer will the lighter Body ſo attracted ſtick to it.

Tyr. Then it will leave the electrified Body at laſt, will it?

Phil. Yes, moſt certainly, after the Virtue or Power given to the electrified Body by Friction ceaſes, and then it is as it were repelled, beat or forced back from the ſaid Body, and will ſuddenly fly off (ſometimes with a Sort of a Snap) but never out of the Sphere of *Attraction*; for by rubbing the Body ſufficiently again they will inſtantly fly to it as if they were compelled back.

Tyr. What may we learn from *Electricity?*

Phil. Many uſeful and amuſing Things, as, 1. That it conſiſts of, or is compounded both with the Power of *Attraction* and *Repulſion*. 2. *Electrical* or electrified Bodies attract all Things; but the *Load-Stone* acts with very little Power or Attraction on many Things, except Iron or Steel. 3. If a light Feather be within the Power of Attraction of an electrical Body, there it will ſtick, and afterwards being repelled will fly off to ſome other Body, but it will always ſtretch out its Fibres towards the electrical Object.

Many other Curioſities are to be obſerved from the Nature or Power of *Electricity*; but particularly this, that not only Plants have received freſh Vegetation by it, but even many Diſorders incident to Mankind, ſome very obſtinate, and others even ſaid to be hereditary, which have baffled all the Rules and Order of a regular Proceſs of Phyſics, have been removed by the Perſons ſubmitting themſelves to be *electrified*.

N. B.

N. B. Dr. *Boyle* ſays, that it is not by Neceſſity that ſmall attracted Bodies come to be electric ones; for if a Piece of Amber be rubbed ſtrongly on any dry or warm Body of as big Size as itſelf, and then taken away, and afterwards tied to a String ſo as to hang perpendicular and quite at reſt; if the Body upon which the Amber was rubbed be put towards the Amber, the Body ſo rubbed will draw the Piece of Amber towards it, which plainly ſhews that other Bodies can move or draw the electric ones. See Dr. *Brown*, Dr. *John Harris* and *Martin* on Electricity.

3. *Of* TRANSPARENCY *and* OPACITY.

Tyr. Pray what do you mean by *Tranſparency?*

Phil. Clearneſs, free from *Cloudineſs*; and is that Property of Bodies which renders them eaſy to be ſeen through, ſo that any Object may be ſeen behind them, or appear much the ſame as if no ſuch tranſparent Body was placed behind the Eye and the Object, though perhaps not quite in the ſame Size and Magnitude.

Tyr. What is this owing to?

Phil. To the Nature or Conſtruction of all ſuch Bodies that admit the Rays of Light to paſs through them immediately in Right Lines; ſuch is the Nature of all *pellucid*, *diaphanous*, or *tranſparent* Bodies, as *Glaſs*, *Cryſtal*, &c. by Reaſon of their Pores, or ſmall Interſtices or Paſſages between the Particles of Matter contained in them; and theſe Pores are ſo great in ſome of theſe Bodies (particularly *Glaſs*) that the Quantity of Matter contained in the Bulk of theſe Bodies bear ſcarce any Proportion to the Size or Bulk itſelf. See Dr. *Keill*'s Introduction.

Tyr. I thank you, Sir; and pray what do you mean by *Opacity?*

Phil. That State or Condition of Bodies which are void of Light, or the Quality of all ſuch Bodies as are dark and opaque, or are not to be ſeen through.

Tyr. I underſtand you, Sir, for I ſee plainly that *Opacity* is a ſecond Darkneſs, as it were; for though it is not really the Want of Light, yet it is Light obſtructed which cannot paſs through ſuch Bodies in right Lines, as in tranſparent Bodies.

Phil. You ſay right, *Tyro*; but you are to obſerve that the ſmall Particles of opaque Bodies will become tranſparent in Liquids, or otherwiſe by filling their Parts

or

or Pores with any Subſtance equal with the Denſity of their Parts. See Dr. *Keill*'s Introduction.

4. *Of* DENSITY *and* RARITY.

Tyr. What do you underſtand by *Denſity?*

Phil. Denſity, according to the common Acceptation of the Word, ſignifies Thickneſs, Solidity, or Compactneſs; but philoſophically, it is the Property of a Body, which ariſes from the Cloſeneſs of its Particles and Smallneſs of its Pores, by which it contains ſuch a Quantity of Matter under ſuch a Bulk: And therefore, in comparing one Body with another, we ſay, ſuch a one is more denſe than the other, which is more rare or thinner.

Tyr. Then I ſee that Rarity is only Thinneſs, or is quite oppoſite to Denſity or Thickneſs.

Phil. You are right.

Tyr. What may we learn from hence?

Phil. Several uſeful Things. 1. If two Bodies have the ſame Denſities, their Maſſes are as their Bulks. 2. The Denſities of any two Bodies are in a Ratio compounded of the direct Proportion of the Quantity of Matter in their Maſſes, and a reciprocal Proportion of the Magnitude of ſuch Maſſes.

Tyr. Pray explain this a little clearer.

Phil. Suppoſe then there were two given Bodies A and B; A has 6 Parts of Matter and 4 Degrees of Magnitude; and let B have 3 Parts of Matter, and 12 Degrees of Magnitude; I ſay then, that A's Denſity is to B's as 5 to 1; that is, 5 Times greater than B's.

Tyr. How do you prove this?

Phil. Place the Numbers Fraction-wiſe, but always obſerve, that the Parts of Matter muſt be made one Fraction, and the Magnitudes of each another Fraction, but ſo that the Degrees of Magnitude which belong to the given Body muſt ſtand athwart or croſsways, and not under its own Parts of Matter; or in other Words, the Degrees of Magnitude of the one Body muſt be a Denominator, to the Parts of Matter in the other; then multiply the Fractions together, and compare the Numerator and Denominator, for that gives the Proportion of their Denſities. Thus in the

Queſtion

Queſtion A $\frac{6}{3} \times \frac{10}{4} = \frac{60}{12} = 5$, therefore A's Denſity is 5 Times greater than B's.

Tyr. I heartily thank you, kind *Philomathes*, for this plain Demonſtration.

Phil. Then we will proceed to the next Thing, *viz.*

5. *Of* HARDNESS *and* SOFTNESS.

Tyr. What do you mean by *Hardneſs*, or wherein does *Hardneſs* conſiſt?

Phil. Hardneſs, in Oppoſition to *Softneſs*, conſiſts of the moſt minute primogenial Particles of Matter conglutinated, ſtuck to, or cohered to each other, in ſuch a Manner, and into ſuch a Firmneſs or Solidity, that the Preſſure of the Finger not being able to make any Alteration on ſuch a Body, ſo as to diſplace any of the Parts, or alter its outward Form or Shape; and the different Degrees of *Hardneſs* ariſe from ſuch Bodies, whoſe conſtituent Particles are flat or ſquare, ſo as to touch each other in many Points; whereas thoſe which are round or ſpherical, touch in fewer Points or leſs Surface, and approach nearer to *Softneſs* or *Liquidity*.

6. *Of* RIGIDITY *and* FLEXIBILITY.

Tyr. I apprehend that *Rigidity* and *Flexibility* are much the ſame as *Hardneſs* and *Softneſs*; are they not?

Phil. No, *Tyro*; *Rigidity* ſignifies *Stiffneſs*, and therefore is in Effect the ſame as *Hardneſs*; for all rigid Bodies are hard: But *Softneſs* and *Flexibility* are not the ſame, for no Body can be ſoft without being *flexible*, but a Body may be *flexible* and not *ſoft*; for *Flexibility* does not ſignify *Softneſs* but *Thinneſs*, or the Nature or Property of ſuch Bodies as are *thin* and *pliable*.

Tyr. I thank you, Sir; and pray what next comes in Courſe?

7. *Of* CONSISTENCY *and* FLUIDITY.

Tyr. What is *Conſiſtency?*

Phil. Conſiſtency ſignifies Thickneſs, and is ſet in Oppoſition to *Fluidity*, and is that State or Property of Bodies, whereby they are fixed like thoſe in a State of Solidity, but may be moved or acted upon with greater Eaſe: It is likewiſe called *Fixidity* or *Fixity*, and ariſes from

from conſtituent Particles, the ſame as thoſe of *Hardneſs* and *Rigidity*, but of a leſs Degree.

Tyr. What is *Fluidity* or *Fluidneſs?*

Phil. That Quality of Bodies, by which the Parts are ſo diſpoſed as to ſlip by or over each other, and flow all Manner of Ways, and will, contrary to Solidity or Hardneſs, give Way to the leaſt Touch or Preſſure.

Tyr. What is the Reaſon or Cauſe of *Fluidity?*

Phil. It ariſes from the Similarity of the original or primogenial Particles of Matter, together with their Lubricity and Smallneſs, whereby they are ſo modified as to produce a fluid Body, ſuch is the Property of Water, Oil, Fire, *&c.*

Tyr. Then I find that *Fluidity* and *Liquidity* are the ſame.

Phil. No; there is a very ſenſible Difference, for *Fluidity* is a general Name for all Bodies whoſe Parts yield to any Touch or Impreſſion, ſuch as Sand, *&c.* which is called a *Fluid* as well as Water, *&c.* but that is called *Liquidity*, or a liquid Body, which when touched leaves a Moiſture or Wet upon the Finger.

8. *Of* HEAT *and* COLD.

Tyr. What is *Heat?*

Phil. Heat is a Senſation of the Mind, the Cauſe of which conſiſts in the Agitation of the ſenſible Parts of the Object, which produces in us that Senſation by which we pronounce the Object ſo agitated to be more or leſs hot or cold; for it is according to the Activity of the Motion of the Particles of the Bodies; no Heat being ſenſible to us but ſuch whoſe Motion of its Parts act ſtronger upon us, and greater than the Organs of our Body. See *Harris*, *Rowning*, and *Martin*.

Tyr. What is *Cold*, or what do you underſtand by it?

Phil. That which is contrary to *Heat*, and void of all the agitated Particles of Fire, and in that State when the Motion of the Parts of a Body is leſs than that of the Organ of our Touch or Feeling; then it excites in us ſuch a Senſation as is called *Cold.*

Tyr. I thank you, Sir; but is not *Fire* and *Light* one and the ſame Thing?

Phil.

Phil. No; but the Particles of Light and Fire act alike in many Reſpects, but yet they are very different; but this I ſhall tell you more of when I come to treat of *Light*.

Tyr. Very well, Sir; but pray what is *Flame?*

Phil. Flame is a *Fluid*, *Fume*, or *Vapour*, ariſing from intenſe or red-hot Bodies, by the Particles being inconceivably agitated, but ever in Motion whilſt there is any Air; for without Air there is no *Flame*, as appears by a Candle which will not burn in a foul or aduſt Air, and a Chimney (or any Vehicle or Tube) on Fire is very eaſily extinguiſhed by ſtopping the Mouth of it with a Blanket, or any Thing proper to keep out the Draught of the Air.

9. *Of* HUMIDITY *and* SICCITY.

Tyr. What is *Humidity?*

Phil. Moiſture or Dampneſs, which has the Quality or Property of wetting or moiſtening other Bodies, but not ſo as to make the wet Particles drop.

Tyr. I ſuppoſe then that it may be called *Fluidity?*

Phil. Not with Propriety, for all *Fluids* will not wet, ſuch as Duſt, Sand, Quickſilver, *&c.*

Tyr. Then, if I apprehend it right, *Humidity* is a Sort of a Medium between *Wetneſs* and *Dryneſs*.

Phil. You are right, for *Humidity* is only a Mixture of Particles left after *Liquidity*, or elſe ſome liquid Particles ariſing, either from Steam or Dampneſs, upon certain Bodies, ſo as to make them *humid* or moiſt.

Tyr. Siccity then, I perceive, is the ſame as Dryneſs, and I ſuppoſe is only the Want of Moiſture; for if a Body ſhould happen to be moiſt, yet if by the Heat of the Sun or Fire the Particles ſhould be exhauſted or driven out by Steam or Vapour, and this Heat keeps ſtill continuing, it will naturally make the Body ſo acted upon very dry, criſped, rumpled, or brittle; and I ſuppoſe this Property, Quality, or State, may be called *Siccity*.

Phil. You are very right, *Tyro*.

10. *Of* ELASTICITY.

Tyr. What is *Elaſticity*, and what does it mean?

Phil.

Phil. It ſignifies Springineſs; and is that Property belonging to certain Bodies, by which they return to their former State, Shape, and Poſition, after they have been put out of ſuch Shape or State. Thus a Stick, Piece of Cane, Whale-Bone, *&c.* being bent, and letting them go ſuddenly, will return with great elaſtic Force and Swiftneſs to their former State: But of all Bodies, Air is moſt remarkably elaſtic; for being compreſſed (or pent up, as it is commonly called) by any Power or Force, when ſuch Power or Force quits the Office of acting upon it, then the Air returns with elaſtic Rapidity to its former Station; but more of this by and by.

Tyr. Are not all Bodies *elaſtic?*

Phil. Yes: None are without the Power or Quality of *Elaſticity*; but this is in a greater or leſs Degree according to the Make, Shape, or Nature of different Bodies. For Inſtance, ſoft Bodies have little or no ſenſible *Elaſticity*, but the Strings of every common Spinnet or Harpſichord not only ſhew the Nature of, but the Difference of *Elaſticity* in Proportion to their Vibration; for the longeſt Wire is *elaſtic* as well as the ſhorteſt; but the ſhorteſt has many leſs Vibrations than the longeſt, and therefore after it is ſtruck reſumes its natural State or Poſition ſooner than the other, and flies back with great Force and Velocity into its original Form; as ſhall be more fully proved, if we have Room to treat of *Vibration*.

II. *Of* ODOURS *and* SAPOURS.

Tyr. What do you mean by *Odours?*

Phil. Such Bodies as excite in us the Senſe of Smelling; but it is more frequently applied to ſuch Bodies which ſend forth ſweet, fragrant, or perfume Scents.

Tyr. What do you apprehend may be the Cauſe of theſe odoriferous Bodies, acting thus upon the Organs of Smelling?

Phil. It ariſes, no Doubt, from exceeding fine, and inſenſible Vapours, which fly off from ſuch Bodies floating in the Air, and acting circularly in all Manner of Directions; but more or leſs according to their *Humidity* or *Siccity*; as appears manifeſt by Flowers whoſe Scent

Scent don't act upon our Sense of Smelling till we are very near them, but when refreshed by Moistures or a small Shower of Rain, may be smelt at a considerable Distance.

Tyr. Pray how do these Scents act upon the Organ or Sense of Smelling?

Phil. The *Effluvia* of these odoriferous Bodies decrease according to the Squares of their Distance: Thus, if there is any odoriferous Body (suppose a Rose, *&c.*) placed 1 Inch, 1 Foot, or Yard, from me, and I smell it to a certain Degree; then let it be removed 2 Inches, 3 Inches, 4 Inches, *&c.* from me, I say, the Scent of it will decrease in Proportion to the Squares of the Distance from the Body: $1\times1=1$, $2\times2=4$, $3\times3=9$, $4\times4=16$, *&c.* so that the Scent will be 16 Times less at 4 Inches off than at 1; 9 Times less at 3 Inches off, and 4 Times less at 2 Inches off; and also 4 Times more at 2 Inches off than at 4 Inches off, because the Square of 2 is 4 Times less than the Square of 4.

12. *Of* LIGHT.

Tyr. What is *Light*, and the Occasion or Cause of it?

Phil. Light is that Sensation in the Organ or Sense of Seeing, whereby all luminous Bodies are not only themselves apparent to our Sight, but all other Objects that the Rays of Light act upon, are clear to our Senses or Perception.—The Cause of Light is unknown to the best Philosophers; it is sufficient, *Tyro*, to say, that it existed only by the immediate Word, or Will of the great Creator.—*Let there be Light*—and there was *Light*.——*Light*, no doubt, is produced from Motion; but then as all Motion will not produce Light, nor is productive of Light, it therefore must be rather the Quality of certain Bodies that are of themselves luminous, and have the constant and invariable Property of emitting or sending forth Rays of Light to our Eyes much finer than Air itself: such is the Property of the Sun, a Star, a Candle, and all Sorts of Flame, *&c.* See Dr. *Halley*'s Micrography, Dr. *Harris* and *Rowning*, and *Martin*.

Tyr.

Tyr. What, do you make *Light* then a Body of itſelf? I thought the Sun was the Fountain or Cauſe of all Light.

Phil. You thought wrong then; for it is evident, that though the Sun is the moſt glorious Body of Light that we at preſent know of, yet it is not the original of Light itſelf: —— For Light is produced a thouſand Ways where the Rays of the Sun have no Connection. ——*Light* is produced by a Candle, by every Flame, by a Flint and Steel, nay, even by Friction and Percuſſion, ſuch as rubbing a Cat's Back, and by many other Things, Ways or Methods.

Tyr. I perceive my Error, and own what you ſay to be true; and if I underſtand you, I ſuppoſe that all luminous Bodies are made up with an infinite Number of Particles of ſuch Matter which are indued with, or have the Property or Quality of *Light*.

Phil. You are right.

Tyr. Does not *Light* fly with incredible Swiftneſs?

Phil. Yes, it flies above (1,500,000) one Million five hundred thouſand Times faſter than a Bullet from the Mouth of a Gun or Cannon, and about (750,000) ſeven hundred and fifty thouſand Times faſter than Sound.

Tyr. This is incredible indeed! But pray, dear *Philo*, give me a little farther Satisfaction of this amazing Swiftneſs.

Phil. It is proved by ſeveral Obſervations, that Sound flies about 1142 Feet in a Second of Time (but ſuppoſe 1140) and a Bullet flies about 622 (but ſuppoſe 620) Feet in a Second of Time, therefore, as the Sun is about 81,000,000 Million of Miles diſtant from the Earth (which is about the ſame Diſtance of Half the Diameter of the Earth's Orbit) a Cannon-Bullet would be upwards of 31 Years in paſſing or arriving from the Earth to the Sun; but *Light* flies from the Sun to us in about 7 ½ Minutes.

Tyr. How do you prove this?

Phil. It is proved by ſeveral Obſervations, but more particularly by the Eclipſes of the *Satellites* of *Jupiter*; for when the Earth is between the Sun and this Planet, thoſe Eclipſes will happen between 7 and 8 Minutes ſooner, than when the Earth is in the contrary Poſition, for

for then Light has got to fly the Diameter of the Earth's Orbit more, which is about 162,000,000 Miles more than before. This plainly proves that Light is progreſſive or propagated in Time, and not inſtantaneous, as was ſuppoſed by ſome antient Philoſophers.

Tyr. I am much obliged to you; but what other Properties or Affections has Light?

Phil. Many, for it is plainly proved long ago, that it is the very Cauſe of thoſe different Colours which appear to us, and are called by the various or diſtinct Names of *Red*, *Yellow*, *Green*, &c. which I ſhall tell you more of when I come to treat of *Colours*. *Light* alſo is *reflexible* and *refrangible*.

Tyr. What do you mean by *reflexible?*

Phil. *Reflexibility* is that Diſpoſition of the Rays of Light by which they are thrown back, or turned from their natural Courſe.

Tyr. What is *Refrangibility?*

Phil. *Refrangibility* is the Diſpoſition of Rays capable of *Refraction*, or being turned out of their Courſe by paſſing into a denſer Medium.

Tyr. Can you give me ſome Examples concerning *Reflexibility* and *Refrangibility?*

Phil. I have not Room for this, becauſe it requires not only Words but great Demonſtrations by Figures; but there are many very curious Things to be obſerved in the Nature of Viſion; and though we ſee Objects plainly, yet they are not always in the very Place that we ſee them with our Eye, for ſometimes we ſee them by Reflexion, and ſometimes by Refraction.

Tyr. Why how can this be!———What, if I ſee an Object plainly in a certain Place, am I to be convinced it is not in that Place?

Phil. I hope ſo; for if it be made appear that you are deceived, certainly you would not dare to deny Truth itſelf upon Experiment.

Tyr. Pray then tell me how this is.

Phil. We are deceived many Ways by the Laws of Reflexion, and Things appear to us not as they really are. For inſtance, take a Tub, whoſe Sides are ſtrait, and in the Middle on the Bottom lay a Shilling, or any other viſible Object, then go backwards ſo far that you can

can but ſee the Object, there ſtand while another Perſon fills the Tub above half full with Water, then you will not ſee the Shilling where you ſaw it at firſt, but it will appear perhaps 1, 2, 3, 4, or 10, 12, or 20 Inches further than it did before: (This is according to the Largeneſs of the Tub and Quantity of Water.) Or otherwiſe, if you walk ſo far backward before the Water is poured in, that you cannot ſee the Shilling on Account of the Edge of the Veſſel or Tub; then let it be filled as before, and you will ſee the Shilling quite plain, but it will not appear to be in the Middle of the Tub where it really is, but will appear as if it were many Inches further from you, and towards the further Side of the Veſſel.

Tyr. This is very ſtrange; pray what is this owing to?

Phil. From Rays, or from a Ray of Light which paſſes from the Shilling towards the Surface of the Water, but there meeting with the Air is refracted out of its Courſe, and ſtrikes the Eye; and as all Bodies are ſeen in a ſtrait Line, ſo will you ſee the Object, but yet not in its Place. From this very Thing, or on the Account of Reflexion and Refraction, the Sun is ſeen every Day, Morning and Evening, above the Horizon, when he is really below, or had been below it 3 ¼ Minutes upon a mean Rate daily.

Tyr. I ſuppoſe then you mean thus, that though the Sun is really ſet, his Rays ſtrike againſt the Atmoſphere, and from thence are refracted and paſs to the Eye of a Spectator then upon the Earth, and as Objects are ſeen in right Lines, a Spectator on the Earth will then ſee the Sun appearing above the Horizon, when he is really below it.

Phil. Yes, I do.

Tyr. What elſe is to be obſerved from Reflexion of the Light, or the Deception of Sight in viewing Objects?

Phil. Yes, 'tis worthy Notice to obſerve, that if an Eye was placed perpendicularly over the Shilling which we were juſt now ſpeaking of in the Veſſel of Water, the Spectator then will not ſee the Shilling or Object at the Bottom of the Tub as it really is, but it

it will ſeem elevated perhaps one third, perhaps half the Depth of the Water, as if the Water bore it up, and yet we are ſenſible the Shilling is at the Bottom.

Tyr. This is very pretty indeed: I intend to try this ſmall Experiment the firſt Opportunity.

Phil. Do ſo; but firſt, if you can, conſult *Martin*'s Philoſophy, p. 67 and 69, and *Rowning*'s Philoſophy, Part III. p. 100 and 134.

Tyr. I heartily thank you, kind *Philomathes*; permit me to aſk you one Queſtion more concerning *Light*, and I will have done: if *Light* flies thus ſwift, and ſpreads itſelf every way with ſuch incredible Velocity, muſt not the Particles be ſurpriſingly ſmall?

Phil. Beyond Conception; for 'tis computed by the beſt Philoſophers, that there flies out of the End of the Flame of a burning Candle in a Second of Time (*viz.* in a Moment) ten thouſand Millions of Times more Particles of *Light* than there are viſible Grains of Sand contained in the Bulk of the whole Earth; the Particles or Number of Grains of Sand being computed to be only 1000000000000000000000000000000000, the other, as I ſaid before, ought to have ten more Cyphers added.

Tyr. I am amazed! This is indeed paſt Conception! —Great God, how infinite are thy Works! How ſtupendous are thy Power and Greatneſs!—

Phil. I'm agreeably ſurprized at your Aſtoniſhment, and am glad you have ſuch a Notion of the Wiſdom and Knowledge of God: For moſt certain it is, that though God has given Angels and Men great Knowledge in many Things, and has kindly condeſcended to reveal ſomething of himſelf to us, yet the Knowledge of all created Beings put together (you ſee) falls infinitely more ſhort of the Knowledge of God himſelf, than the ſmalleſt Particle of *Light* compared in Size with all the Bodies of the Univerſe collected together in one Maſs. And though I dare be bound to ſay, that even the whole Earth would not contain the Number of Figures of the Difference between one of theſe inconceivable Particles of *Light*, compared with ſuch an enormous Bulk of Matter; yet a Compariſon may be made between all finite Things; but who can comprehend, or who can compare with Senſe or Propriety the Knowledge of the

Creature

Creature with the Creator!——See *Job*, Chap. xxvi. Verſe 6, to the 14th, alſo *Eccleſ.* Chap. xxxix. and the 6 laſt Verſes.

13. *Of* Colours.

Tyr. What do you mean by *Colours?*

Phil. Colours are thoſe Qualities of certain Bodies which admit of certain Rays of Light, ſo diſpoſed as to reflect them back upon the Organs of Sight, ſo as to cauſe in us the Senſation of different Colours.

Tyr. You ſeem then to hint as if the Cauſe of Colours proceeds from the Rays of Light.

Phil. It is very evident, that there would be no Colour at all without Light; and 'tis as evident that all Colours proceed from the Rays of *Light*, becauſe in thoſe Rays are contained all the primary, pure, original Colours.

Tyr. Pray explain this more fully to me, for I do not quite apprehend you.

Phil. It is obſerved, that there are different Species of Rays of *Light*, which have different Degrees of Refrangibility, in paſſing from one Medium to another, and, according to this Refrangibility and Diſpoſition, they act upon us ſo as to cauſe *red*, *green*, *blue*, &c.

Tyr. This is very ſtrange; but I am not fully ſatisfied yet, why ſuch *Colours* appear to us under ſuch Names as *red*, *green*, &c. except I can have a more ſufficient Proof of it: You'll excuſe the Freedom, *Philomathes*, I make no Doubt; for you deſired I would not be backward in aſking Queſtions; and your Charge to me was always to be ſatisfied with, and clear in all your kind Inſtructions.

Phil. I own it, and I am pleaſed that you do ſo much Juſtice to yourſelf. Obſerve then, there are certain Species of the Rays of Light, and each is ſo diſpoſed as to excite in us the Idea of a different Colour.

Tyr. What do you call the principal or primary Colours, from whoſe intermediate Spaces the other Variety may be produced and accounted for?

Phil. The Rays of Light being refracted, will produce, 1. *Red*, 2. *Orange*, 3. *Yellow*, 4. *Green*, 5. *Blue*, 6. *Indico*, and 7. *Violet*; and theſe Colours are diſtinguiſhed

guiſhed according to the Refrangibility of the Rays. Thus the leaſt refrangible Ray will appear *red*, and the greateſt refrangible Ray will be the very deepeſt *Violet*, and the intermediate Colours between them will be the other Colours before-mentioned, or a Mixture of thoſe different Colours approaching, more or leſs, to each Colour, according to the neareſt or fartheſt refrangible Ray.

Tyr. Sir, I am obliged to you, and I perceive my Miſtake, for I uſed to think that Colours were natural to certain Bodies; but now I plainly ſee that they appear ſo, according to the different Rays of Light painted upon, or capable of being received by them, to cauſe ſuch Colours to effect our Sight.

Phil. You are right; but I will ſatisfy you further by an Experiment, which you may try at any Time: That is, only to make a Lather with Sope and Water, then take a Pipe (that we commonly ſmoke in) and fill the Bowl full, and gently blow at the End, and you will find Bubbles ariſe, which you may blow off at Pleaſure (as Children do), or ſuſpend them on the Top of the Bowl; then let two, three, or more Perſons carefully obſerve the different Colours of thoſe Bubbles as they ariſe from the Bowl of the Pipe, (which is ſuppoſed to be done when the Sun ſhines) and they will perceive firſt *Red*, then perhaps *Blue*, and by a Continuance of blowing or raiſing the Bubble, or depreſſing it, then will appear *Orange*, *Green*, *Blue*, *Violet*, and in ſhort here and there all Manner of Colours; then will appear for a while a *Yellow*, then *White*, and at laſt a Sort of *Black*.

Tyr. You are very obliging, my dear *Philomathes*; but ſince you have mentioned *Black* and *White*, pray give me ſome Account of them, for I'm at a Loſs how to define them?

Phil. *Black* and *White* are never reckoned among the primary Colours; becauſe *Black* cannot with any Propriety be called a Colour, it being a Deprivation of all Light, for the Subſtance abſorbeth or ſucks up all the Rays, and therefore can reflect none. Now *White* may be called a Colour, becauſe in this are comprehended all the primary Colours in one.

Tyr. I don't underſtand this, Sir, at all; what if I mix all the Colours together would they be *White?*

Phil. Doubtleſs they would.

Tyr. Pray, *Philomathes*, give me a Demonſtration.

Phil. I could prove it to you by many Experiments, but this one will be ſufficient to convince you, and being very eaſy you may try it at Leiſure.

It is found by Experience, that any Body being divided into 360 equal Parts, on which the aforeſaid Colours fall, that the *Red* Colour will take up 45 Degrees or Gradations of ſuch Parts; *Orange* 27; *Yellow* 48; *Green* 60; *Blue* 60; *Indico* 40, and *Violet* 80 = in all to 360. Now, take a Wheel, and paint the Circumference with 45 of *Red*, 27 of *Orange* Colour, *&c.* as afore directed; then let the Wheel be turned very ſwift round, and none of theſe Colours will be ſeen, but the whole Circumference will appear as if it were painted over with the very beſt *White*.

Tyro. Vaſtly eaſy to try, and very ſurpriſing to conſider; but ſuppoſe I do not divide the Circumference juſt in the Manner or Proportion you directed; how then?

Phil. Then you will not have a perfect *White*, nor will you have any one of the Colours before-mentioned, but a Variation of Colours according to the Proportion of each Colour promiſcuouſly laid on, which will partake Part of one Colour, Part of another, like the Bubble blown out of the Tobacco-Pipe. If you would be fully ſatisfied in this Theory of Colours, ſee Dr. *Harris*'s Lexicon, *Derham*'s and *Rowning*'s Philoſophy.

14. *Of* SOUNDS.

Tyr. What is the Cauſe of *Sounds?*

Phil. Sounds are cauſed by the undulatory Motion of the Air when the Particles thereof are put in Motion by a Stroke on Bodies, which cauſes firſt of all a tremulous Motion in them, and then by Means of the undulatory Motion of the Air beats upon the *Tympanum* or Drum of the Ear, and affects the Nerves in ſuch a Manner ſo as to cauſe in us this Senſation.

Tyr. How is it proved, that Air is the principal Cauſe of *Sounds?*

Phil.

Phil. Several Ways, but by none more than by the Experiment of the Air-Pump; for a ſmall Bell may be heard a great Diſtance before the Air is exhauſted, but when it is put into the Receiver, and the Air exhauſted, you can then ſcarce hear it.

Tyr. I think, if I remember, you told me that *Sound* flies about 1100 Feet in a Second of Time, that is, 1 Million 3 Hundred and 20 Thouſand Yards, or 7500 Miles in an Hour, which is about 8 Hundred Thouſand Times leſs in Velocity than *Light*.

Phil. I did ſo, and why do you repeat this again?

Tyr. I cannot help it, when I think of the Velocity of Light being ſo incredibly ſwift: I aſk Pardon; but pray how far are Sounds in general to be heard?

Phil. It has been aſſerted, that *Sounds* continued or repeated have been heard at an incredible Diſtance. Thus Mr. *Clare* affirms, that he heard the Watch-Word, *(viz. All is well)* called by the Centinel from *Old* to *New Gibraltar*, which is upwards of 10½ Miles; and Dr. *Hearne* aſſerts, that in the Year 1685 Guns fired at *Stockholm* were heard 180 Miles; and in the *Dutch* War, 1672, they were heard near 200 Miles.

Tyr. I could never have thought Sounds could have been heard ſo far: But pray is there not a Difference between Sound flying before the Wind, and againſt it?

Phil. There is, but not ſo much as ſome Perſons imagine.

Tyr. Does not Sound fly equal Spaces in equal Times?

Phil. Yes it does, whether in Summer or Winter, Day or Night; but then the Sound is not always equally ſtrong, nor ſo full upon our Ears; for no Doubt but the Strength of Wind for and againſt, and alſo a thinner or denſer Air will cauſe a Difference in this Reſpect; but yet not ſo much as is ſuppoſed in common.

Tyr. I'm obliged to you, *Philomathes*; but pray give me Leave to aſk you how it happens, that ſome Sounds are ſo agreeable and harmonious, while others are ſo diſſonant and diſagreeable?

Phil. Your Queſtion, *Tyro*, is very difficult to anſwer, on Account of the Prolixity which it naturally requires; and not only this, but even on the Account of the

Words *agreeable* and *diſagreeable*; for you are to know for a Certainty, that *that* Sound which is now diſagreeable, may the next Minute become very agreeable to you.

Tyr. How can this be?

Phil. It is ſo indeed, according to what other Tone or Sound it is accompanied with.

Tyr. You ſpeak of *Sounds* relating to *Muſic*, I perceive.

Phil. I do ſo.

Tyr. I wiſh you would give me ſome Account of the Nature and Paſſages of Muſical Sounds.

Phil. That I ſhall do under the Word *Muſic*.

Tyr. Pray then, before you leave this Head, tell me the Cauſe of *Echoes*, or why *Sounds* ſometimes anſwer back or repeat the ſame Word?

Phil. An *Echo* is cauſed by the vibrating Air being abrupted in its Paſſage. For, as the Air rolls or paſſes along like a Wave, it often meets with various Objects, and by ſtriking againſt them, is reflected back to us, and cauſes new Vibrations, which (if the Object lies in a proper Situation) return to us and repeat the ſame Tone, Sound, or Word, as was firſt given, not only once, but ſeveral Times.

Tyr. This is very natural indeed, and eaſy to be conceived.

Phil. I told you that ſometimes Words are repeated ſeveral Times; but I have myſelf been in Places that would repeat 8, 10, or 12 Times over your Name, if I had called you once very loud.

Tyr. That's very extraordinary.

Phil. Not at all; for it is affirmed, that in *Woodſtock* Park near *Oxford*, there is an *Echo*, which will *echo* or repeat 16 or 17 diſtinct Syllables any Time of the Day, and from 11 at Night to 3 in the Morning, it will repeat 20 Syllables, or a Monoſyllable 20 Times over.

Tyr. But pray what is the Reaſon that it repeats more by Night than by Day?

Phil. Becauſe the Air being more denſe, the Vibrations are ſlower, and of Conſequence a Repetition of more Syllables to be heard. See Dr. *Plot*'s Hiſtory of *Oxfordſhire*, and Dr. *Harris* under the Word *Echo*.

SECT.

SECT. VII.

Of Wind, Rain, Hail, Froſt, Snow, and Ice.

1. *Of the* WIND.

Tyr. What is *Wind?*

Phil. A great Motion, Stream, or Torrent of Air.

Tyr. From what does this ariſe?

Phil. From many Cauſes, but 'tis chiefly believed to ariſe from the ſwift and rapid Rotundity of the diurnal Motion of the Earth round its Axis, which leaves the fluid and refined Particles of Air behind; and then they uſher or break forth at certain Times into a violent Agitation, *&c.* But be this as it will, it is certain that the Air being turned out of its proper Order or Equilibrium; ſome Part thereof is put into greater Agitation than others, ſo as to produce a Stream of Air, a Storm or high Wind.

Tyr. But pray is not the Wind more regular in ſome Parts of the Globe than others?

Phil. Yes.

Tyr. Are there not different Sorts of Winds pray?

Phil. Yes; there are common or accidental Winds, 2 general Trade Winds, and 3 periodical Winds, called or named Monſoons by Lord *Bacon.*

Tyr. What do you mean by trading Winds?

Phil. They are ſuch as blow from one Quarter; thus in the *Atlantic* Ocean, they blow from the North-Eaſt, or about North-Eaſt to 30 Degrees Latitude on the North Side of the Equator; and in the *Ethiopic* and *Indian* Oceans, and great *South-Sea*, they blow from South-Eaſt about the South-Eaſt for about 30 Degrees Latitude on the South Side of the Equator.

Tyr. What is the Property of the *Monſoons*, or ſhifting periodical Trade-Winds?

Phil. They are ſuch which blow, ſome 3 Months one Way, and three the other; but the moſt regular or noted *Monſoons* are thoſe which blow 6 Months one Way and 6 the other.

Tyr. Pray where is this, and what Time of the Year is it?

Phil. The *Monſoons* blow from the S. W. to the N. E. from *April* till the Beginning of *October*, in or about 50 Degrees Eaſt Longitude at the Equator, upon the Eaſtern Coaſt of *Africa*, paſſing from the *Eaſtern Ocean* croſs the *Arabian Sea*; and then from *September* till *March*, they return and blow S. W. But below the Bay of *Bengal*, as alſo about 10 Degrees on the South-Side of the *India* Ocean, they blow 3 Months one Way and 3 the other.

Tyr. This is very ſtrange; but I ſuppoſe there is no immediate accounting for it.

Phil. There are ſeveral Reaſons to be given, why it may be ſo; ſuch as when the Sun paſſes the Equator Northward, he no doubt begins to refreſh and warm thoſe Countries, and the Air being leſs rarified by the Heat of its Beams becomes more ponderous, and poſſibly may cauſe or carry with them ſuch a Motion of the Winds; and then, in the Return to the South the other Half-Year, cauſe the *Monſoons* alſo to return with them. There are ſeveral other ſuppoſed Reaſons; but as they are not capable of ſo clear a Demonſtration as many other Things, muſt be left to future Time for further Diſcoveries.

Tyr. What Degree of Velocity has Wind in general?

Phil. Dr. *Derham* and many others have plainly proved, that a gentle Breeze or a very ſmall Wind does not move above 1 Mile an Hour; a briſk Wind flies from 15 to 30; in a Storm from 30 to 50, and in a very great Storm from 50 to 60 Miles an Hour.——See Dr. *Derham*, Dr. *Harris*, *Rowning* and *Martin*; but particularly Lord *Bacon*'s Hiſtory of the Wind, and the Philoſ. Tranſ. No. 183.

2. *Of Rain, Hail, Froſt, Snow, &c.*

Tyr. What is *Rain?*

Phil. Water deſcending from the Clouds, being broken by the Reſiſtance of the Air, falls upon the Earth in ſmall or great Drops, according to the Quantity contained in the Clouds, and is more or leſs in the Velocity of its Deſcent, according to the Weight thereof, or being driven by the Wind, *&c.*

Tyr.

Tyr. Is not *Dew* like *Rain*, or has it not the Properties?

Phil. It has; but in this they differ, that whenever the Water in the Clouds is heavier than the Air, it rains; but *Dew* being a moiſt, inſenſible Miſt raiſed by the Heat of the Earth after Sun-ſet, aſcends like a Fog; but meeting with a colder Air falls in ſmall Drops on the Ground, and is ſo very fine in its Particles as to reſt even on the very Tops of the ſmall and tender Graſs.

Tyr. What is *Hail?*

Phil. Rain congealed more or leſs, according to the Height of the Clouds and the Coldneſs of the Region. Some Authors differ in their Opinions concerning it; the one aſſerts it is frozen in the Clouds before it deſcends; and others ſay it is congealed in its Paſſage.

Tyr. What is *Froſt?*

Phil. That State or Condition of the Air which becomes ſo exceeding cold, ſo as to freeze Water, or by which the Motion and Fluidity of Liquors are ſuſpended, and become thick and frozen. Some ſay it ariſes from ſalt, ſaline Particles of Air, which are ſo ſharp pointed as to fix or inſinuate themſelves into the Pores of Water, and make hard the ſuperficial Parts, and when increaſed becomes more and more a thick Ice. But, ſtrictly ſpeaking, 'tis the moiſt Surface of the Earth being encruſted, which we call *Froſt*, and the *cryſtalized* Superfices of the Water is called *Ice*.

SECT. VIII.

Of Meteors, Thunder, Lightning, Thunder-Bolt, &c.

1. *Of* METEORS *and* VAPOURS.

Tyr. What do you call *Meteors*, and what are the Cauſes of the different Sorts?

Phil. Meteors are mixt, changeable, moveable, and imperfect Bodies, formed by Damps, Heats, and ſpirituous Exhalations out of the common Elements, ſome of which are very high in the Air, and others here and there upon, or very near the Surface of the Earth: There are ſeveral Sorts, 1ſt. *Fiery* Meteors, compoſed

of fat, ſalt, and ſulphureous Exhalations, which are kindled in the Region of the Air, by violent claſhing together in nitrous Air. 2. *Airy* Meteors; theſe are ſuch as are produced from the Wind only, which often cauſes very odd Appearances in the Clouds, in Shape and Order. 3dly, *Watry* Meteors; theſe are ſuch as proceed from *Vapours*; then theſe Vapours turn often to *Miſts*, theſe to *Clouds*, and Clouds to *Rain*, as was ſaid before.

Tyr. Pray, Sir, what do you call *Vapours?*

Phil. Small Particles of any Fluids ſeparated or diſſipated by Heat, which naturally aſcend into the Air, or by Exhalation are drawn off from the Surface, or otherwiſe are forced up by Heat under the fluid Body, ſo as to cauſe a *Steam*, which in ſome Caſes may be called a Vapour, becauſe the Liquor is evaporated or drawn off.

Tyr. I underſtand you; and I have often admired the Number of Particles that fly off in boiling Liquors, which decreaſe the whole ſo inſenſibly by Degrees, that few Perſons pay any Regard to the Cauſe, and yet are often ſurpriſed at the Effect.

Phil. You ſay right, *Tyro*; for ſeveral Liquors will waſte ¼ of the whole in one Hour; ſome more and ſome leſs, according to the Thinneſs or Thickneſs of the Fluidity.

Tyr. Then I perceive the Quantity of Steam or the Vapours are in Proportion to the liquid Surface of the Body.

Phil. No Doubt of it; for 'tis computed by Dr. *Halley*, and ſeveral other eminent Mathematicians, that there is evaporated every Day out of the River of *Thames*, only in its whole Extent, about 20 Million Tons of Water every Day; but there is evaporated out of the *Mediterranean* upwards of 5 Thouſand Million Tons every Day; what then muſt the Weight and Quantity be evaporated from the Surface of all the Oceans?

2. *Of* Clouds.

Tyr. I am ſurprized at the Quantity of Water, *&c.* drawn off by Evaporation; pray where does it go to?

Phil. I told you before into the Air, and by a Congeries or continual gathering together, mix with one another,

another, and become thicker and more denſe, ſo as to form *Clouds* of various Sizes, Thickneſs, Shape, Colour, Weight, &c. The lighter Sort flying more lofty in the Air, while others more condenſe or weightier, float or fly nearer the Earth.

Tyr. I know the *Clouds*, fly very low ſometimes, and I have heard that in ſeveral Places in *England*, but more particularly in *Scotland*, ſome Perſons have ſeen the Clouds paſs much lower than the Hills they have been travelling over.

Phil. No Doubt of it; for it is evident that the Clouds ſometimes are not above $\frac{1}{4}$th of a Mile high, which is much leſs than many Mountains in *Great-Britain*.

Tyr. What is the Shape and Colour of Clouds owing to?

Phil. The Colour of Clouds, or the different Colours of any Cloud, is no Doubt owing to the Rays of Light falling on them in different Poſitions; and as to their Shape, it is eaſy and natural to ſuppoſe, that this is owing to nothing but the different Force of Air or Wind, which drives them here and there; and therefore, from their voluble or looſe Texture, produce various Forms and Shapes.

Tyr. I believe this is true, becauſe in very calm Days and Nights the Clouds ſeem as if they were fixed; at leaſt their Motion is very inſignificant to what it is at other Times.

Phil. You judge very right, *Tyro*.

Tyr. Pray what other airy Meteors are there?

Phil. The next Thing I ſhall give you a little Account of is,

3. *Of* THUNDER *and* LIGHTNING.

Tyr. What is the Cauſe of *Thunder* and *Lightning*?

Phil. *Thunder* and *Lightning*, the moſt dreadful and dangerous of all *Meteors*, are thus accounted for. The Air, abounding (in hot Weather) with *Acids*, *Bitumen*, *Nitre*, *Sulphur*, &c. exhaled from various Bodies, and raiſed by the Sun's Heat into the Region thereof, and are there driven to and fro by the Wind, and being ſhut in between the Clouds and Atmoſphere; their *ſharp*, *unctuous*,

unctuous, *ſpirituous*, *nitrous*, and *ſulphureous* Particles, being mixed together, and violently agitated and furiouſly acting upon, or ſtriking againſt each other, force themſelves, or are forced through the Clouds with an Exploſion or Noiſe, called *Thunder*, accompanied with a Flame or Flaſh, which we call *Lightning*.

Tyr. Which of theſe do you ſuppoſe cauſe the *Thunder*, and which the *Lightning*?

Phil. The *bitumous* and *ſulphureous* Particles occaſion the *Flaſh*, and the *ſaline* and *nitrous* Particles, no Doubt, cauſe the Noiſe or Exploſion, as plainly appears from the very Property of Gun-Powder.

Tyr. What is the Reaſon of our ſeeing the *Flaſh* of *Lightning* for ſome Time before we hear the *Thunder*?

Phil. Certainly, *Tyro*, you forget what you have but juſt before read concerning the incredible Swiftneſs of *Light*, otherwiſe you would never have aſked ſuch a Queſtion.

Tyr. I aſk Pardon, indeed, and own it was for want of Thought; for I perceive the Reaſon is plain: For *Light* flying much ſwifter than Sound, it muſt of Courſe be ſeen much ſooner than Sound can be heard from the ſame Diſtance.

Phil. Now, indeed you give me Pleaſure; for is it not the ſame by the Diſcharge of any Gun or Cannon? every Body knows that the Flaſh is ſeen long before the Sound is heard.

Tyr. I'm quite clear in the whole thus far; and conclude from hence that 'tis poſſible, by obſerving the Time or Interval, between the Flaſh and the Sound of the Exploſion, to tell the Diſtance of the Cloud from us.

Phil. Yes, very eaſily, by comparing the Proportion of one with the other, as before directed.

Tyr. But pray give me ſome Account of the Nature of an Exploſion, or wherein, or in what Reſpect you think it dangerous or not dangerous?

Phil. There is no Certainty, *Tyro*, in this; for if there was, then of Courſe, thoſe that know more of theſe Things than others do, would always take Care to avoid the Danger that they foreſaw. Plain it is then, that the Danger lies, more or leſs, in the Nearneſs or Diſtance of ſuch Exploſion. *Tyr.*

Tyr. I am quite clear in the Truth of this. But pray, Sir, what do you ſay concerning the *Thunderbolt?*

Phil. I ſay, *Tyro*, there is no ſuch Thing as it is commonly reported to be, ſuch as a large Bolt, Shell or Stone; but it is the more intenſe and moſt rapid Flame, which flies from the Clouds with incredible Swiftneſs immediately upon the breaking of the Cloud, and breaks down, drives before it, cuts off and deſtroys every Thing it meets with, even Towers, Trees, and even Mountains or Parts of Mountains, driving up the Stones and Earth for a conſiderable Diſtance, and in vaſt Quantities.

Tyr. What other Properties has this ſubtile and intenſe *Lightning?*

Phil. It is affirmed by ſeveral credible and eminent Writers, that it will ſometimes break the Bones and not hurt the Clothes, break a Sword in the Scabbard and not hurt the Scabbard, *&c. &c.* The Reaſon ſome Philoſophers give (but it is mere Suppoſition) is, that the Particles of Light in different Flaſhes are different in the Reſpect of their Figure and Quality; but I ſhould think it rather proceeds from the Intenſity of them, and their incredible Velocity; for you remember the greater the Velocity or Celerity, the greater the Stroke or Force.

4. *Of other* METEORS.

Tyr. I am obliged to you, *Philomathes*, but pray what other *Phenomena* of *Meteors* can you tell me of?

Phil. There are many other *Meteors*, ſuch as, 1. The *Chaſma*, or a ſhining from or between the Breaks of different Clouds, when they juſt ſplit or part. 2. The *Lampas*, or Lamp burning in one Part only. 3. *Bolis* or *Dart*, when the Fire or Light is very long, and flies like a Dart. 4. *Draco Volans*, or flying Dragon. 5. *Capra Saltans*, or the ſkipping Goat. 6. *Stellæ Cadentes*, or Falling Stars, which is when the more firm or ſubtile Parts are burnt away. There are many other Sorts of *fiery*, *airy*, and *watry Meteors*; but none of them are ſo much noted as the *Ignis Fatuus*, both for its Shape, different Appearance, and other Oddities.

Tyr. Pray what is the Cauſe of them, and where are they moſt frequently ſeen? *Phil.*

Phil. The *Ignis Fatuus* (vulgarly called by ſome *Jack* with a *Lanthorn*, and by others *Will* with a *Wiſp*) is cauſed by ſome fat or unctuous Vapours ariſing, which are immediately kindled, and by the Motion of the Air are wafted about here and there, on or near the Surface of the Earth, and often look like a Light in a Lanthorn. The moſt common Places where theſe are ſeen are in Church-Yards that lie flat and low, and alſo in boggy moiſt Ground and Marſhes, and ſometimes they appear in the more upland Places; but then it is to be obſerved, it is ſuch that border upon, or near ſuch boggy Grounds, and being wafted or driven thither, they ſoon go out, to what thoſe do that continue in the more fat or unctuous Soil.

Tyr. You will excuſe me, I hope, *Philomathes*; but pray give me ſome further Account of this odd *Phenomena?*

Phil. I think, *Tyro*, you are vaſtly curious of aſking odd Queſtions: I really ſuſpect that you are afraid of Mr. *Jack* a *Lanthorn*. — Come, be free, and tell me if you know or have heard any Thing in particular about it.

Tyr. Dear Sir! I could tell you a hundred Stories that my Father, my Uncle, and ſeveral Neighbours have told concerning this, that, and the other Perſon, having been led out of the Way by theſe Lights; others have been terribly frightened, as not to recover it for a long Time after.

Phil. You make me laugh to ſee how earneſt you tell this Tale; and yet I am a little vext to think you ſo filly as to think that there is any Danger in poor *Jack.*———See, *Tyro*, what the Prejudice of Education is: This plainly ſhews us the great Weakneſs and Folly of thoſe Parents and Nurſes, who tell ridiculous bugbear Stories to Children, of Apparitions, Noiſes, *Jack* a *Lanthorns*, &c. which poſſeſs their little Minds with ſuch early Fear and Dread, that oftentimes they never get clear of.

Tyr. What I tell you I know to be true, and perhaps, *Philomathes*, you may not have had the Opportunity of ſeeing theſe Things, though you have read of them.

Phil.

Phil. Here you are miſtaken again, *Tyro*; for I have ſeen ſometimes ten, at other Times upwards of thirty together in one Ground, running here and there with great Swiftneſs, and ſometimes mixt together as if they were dancing, then all at once ſeveral of them have diſappeared, (which I ſuppoſe was occaſioned by their ſtriking againſt one another, or againſt ſome Object) and thus by their ſtrange Appearance and different Poſitions, they become a Terror to many People, but particularly young Folks, whoſe Ears and Minds have been too much filled with idle Tales of the Danger that attends theſe Meteors.

Tyr. But pray, Sir, did you never know or hear yourſelf that any Body was led out of their Way by the *Jack* a *Lanthorn?*

Phil. Yes many; ſo that they have not found their Way home by the Hours together, and gone Miles and Miles out of their Way; but then, as I obſerved before, I cannot allow that *Jack* leads them out of the Way, ſo much as the previous Fear of the Perſons themſelves; for when the *Will with the Wiſp* happens to overtake or approach near them, they are ſtruck with a Surprize at ſo ſhining a Light, and ſo diſmal an Hobgoblin, that they immediately in a Fright turn, or run out of the direct Path-Way, down any Turning, or into any other Field, which leads them quite contrary to their Home. But you may depend upon it, *Tyro*, that Reſolution and a good Preſence of Mind would prevent theſe Inconveniencies and Diſaſters.

Tyr. I am clear in your Opinion indeed; but what would you have poor innocent Children do, who have been and ſtill are poſſeſſed with ſuch Notions?

Phil. I heartily pity them, and blame thoſe that inſinuate ſuch Traſh into their early Minds, inſtead of Things of more Moment; and thoſe who have been ſo unhappily brought up, and have had ſuch Fear and Dread inſtilled into their Minds: You, and all other Perſons, therefore, that know there is no Occaſion for ſuch Fear, ſhould try to convince them of their Error, and diſſuade them from giving Heed to all fooliſh Fancies, and idle, ignorant, and inconſiſtent Stories of every Sort.

Tyr.

Tyr. What you ſay is very true, *Philomathes*, and I ſhall do my Endeavour to improve my Acquaintance at at all Opportunities.

Phil. This is the greateſt Mark of a noble and generous Spirit, *Tyro*, and not only anſwers the very End of my inſtructing you, but undoubtedly anſwers the chief End of that little Knowledge which the great Benefactor has ſo freely given us; and in nothing we can more imitate him than by freely communicating every uſeful Thing to others.

Tyr. Have you any other Meteors that you can give me an Account of?

Phil. Yes, there are many others, ſuch as the *Rainbow*, and *Aurora Borealis*, or Lights in the North; but I cannot well give you an Account of theſe at preſent.

Tyr. Pray, *Philomathes*, oblige me ſo far, though it be ever ſo ſhort.

Phil. Then I aſſure you ſhort it muſt be.

SECT. IX.

Of the Rainbow, Parheliums, and Aurora Borealis, or Northern Lights.

Tyr. What is the *Rainbow?*

Phil. The *Rainbow* is a Meteor in the Sky, appearing in the Time of Rain, or juſt after it, in the Form of a Bow.

Tyr. What is the Occaſion or Cauſe of its Appearance?

Phil. It is occaſioned or produced by the falling Drops or Particles of Rain, by the Reflection and Refraction of the Rays of Light falling upon them.

Tyr. What is the Reaſon of the various Colours in the *Bow?*

Phil. The very ſame that I told you before concerning *Colours*; that the leaſt refrangible Rays produce or paint Red, and the moſt refrangible ones naturally produce Blue and Violet.

Tyr. I forgot myſelf indeed, *Philomathes:* But pray let me aſk you why ſome *Bows* appear ſo very large to what others do?

Phil.

Phil. This is owing wholly to the Height of the Sun; for when the Sun is in the Meridian or higheſt Altitude, the *Bow* will be leaſt to our Sight, being only a Segment of a Circle; but if the Sun be in the Horizon, or juſt ſetting, then the *Bow* is as large as it can be, being very nearly a Semi-Circle.

Tyr. This is very natural to conceive; but pray what Part of the Hemiſphere does the *Bow* generally appear in?

Phil. Always oppoſite to the Sun; I ſay always oppoſite, which ſhews an invariable Rule where to find it, and as true a Fact that it is cauſed by the Rays of the Sun, ſhining upon the falling Drops of Rain.

Tyr. But I have ſeen two *Bows* ſometimes, what is the Reaſon of that?

Phil. The Reflection from the real *Bow* itſelf, which when the Sun ſhines very bright, and the oppoſite Part of the Heavens is dark and cloudy, there are always ſeen two *Bows*, and ſometimes three, two of which are vulgarly called *Weather-heads*.

Tyr. I'm obliged to you, Sir.

2. *Of* Parheliums, Halo's, *&c.*

Tyr. What are *Parheliums?*

Phil. They are what are commonly called mock Suns, and are cauſed by Reflection.

Tyr. Are they tinged then with different Colours as the Rainbow is?

Phil. Sometimes they are, and ſometimes not; but I imagine this is more or leſs owing to the Strength of the Rays of Light, and Poſition of the Spectators.

Tyr. I think I have heard there has been ſeen two or three mock Suns at once.

Phil. I make no Doubt of it, there has been ſeen two ſeveral Times in *England* and *Scotland*; but there was ſeen in *Rome*, *March* 1629, no leſs than four, one of which was very much tinged with various Colours like the *Rainbow*, and the others more faintly ſo.

Tyr. What are *Halo's?*

Phil. They are luminous *Meteors* in the Form of a Ring or Circle, appearing round the Sun and Moon, and ſometimes the Stars.

Tyr.

Tyr. What is ſuppoſed to be the Cauſe of *Halo's?*

Phil. As the *Rainbow* is cauſed by the Reflection of Light on the Drops of falling Rain, ſo are *Halo's* cauſed by the Reflection of Light on ſmall Hailſtones; for whereas the firſt are ſeen only in rainy Weather, ſo theſe *Halo's* appear only in froſty Weather, in rhimy, thick, or froſty Nights or Days, round the Sun and Moon, having them for their common Center.

3. *Of the* AURORA BOREALIS, *or Northern Lights.*

Tyr. I ſhall be glad to hear ſomething about Lights in the Air, for I have been terribly afraid of them ſome Years ago.

Phil. I make no Doubt of it, for they are ſometimes very ſtriking to the Senſes, and carry ſomething dreadful with them when they fly with ſuch Rapidity, and ſeem to claſh furiouſly together in the Zenith.

Tyr. Very true, *Philomathes*, and eſpecially when they look very angry, being tinged with Red, or bloody-coloured, as I have often ſeen them.

Phil. What you ſay is very true; but, however, there is not the leaſt Occaſion to be afraid of them, as there is not the leaſt Danger ariſing from them, as there often is from Lightning and Exploſion from Clouds vaſtly lower.

Tyr. But what do you apprehend is the Cauſe, or what do the moſt eminent Authors ſay upon this Subject?

Phil. There have been various Reaſons aſſigned by different Mathematicians and Philoſophers, but there is no Room to give you theſe different Opinions; but this is plain, no Doubt, that there are certain Steams, Exhalations or Vapours, that riſe from Mines, Vulcano's, *&c.* which are ſulphureous and inflammable, and being ſo very fine and thin, float in the Air, and neceſſarily and naturally, according to their Quantity, Force, or Celerity, ſhoot upwards towards the Zenith; and though theſe Steams are very wide below, yet they will in their Aſcent appear pyramidical, or to terminate in a Point at their higheſt or vertical Extents; but ſometimes they ſhoot even beyond the Zenith itſelf, but then expand, vaniſh, or are loſt to the Sight: One would naturally think they muſt proceed from ſomething inflammable,

for

for they have the very Action of Light and Lightning, except it be that theſe aſcend, being light and very fine, but Lightning deſcends, by Force and Exploſion.

Tyr. But I have heard and read alſo, that this ſtrange Phænomenon is never ſeen near the Equator.

Phil. Very true, and it was once a great Rarity in *England*, but now common, though there have been no remarkable ones (in general Extent) except thoſe in 1574, 1716, and 1727; but thoſe in 1716 extended from *Ireland* to the Confines of *Ruſſia*, *Poland*, *&c.* Thus much for this extraordinary Meteor; only it is to be obſerved, that after theſe fiery Steams have ſpent themſelves for want of freſh Supply of Matter, there is left in general, a ſteady bright Light in the North. If you would know the Particulars of the *Aurora Borealis*, ſee *Rowning*'s Philoſ. Vol. 1. Part 2. p. 147, *&c.*

SECT. X.

Of Tides, or the Flux and Reflux of the Sea.

Tyr. Of all Things in the Laws of Nature, I think nothing more wonderful, and to be admired, than the Flux and Reflux of Waters.

Phil. It is very true; and though the natural Cauſe is known, yet there is ſomething aſtoniſhing, when we conſider ſuch an immenſe Quantity of Water to roll backward and forward in ſuch conſtant and periodical Order.

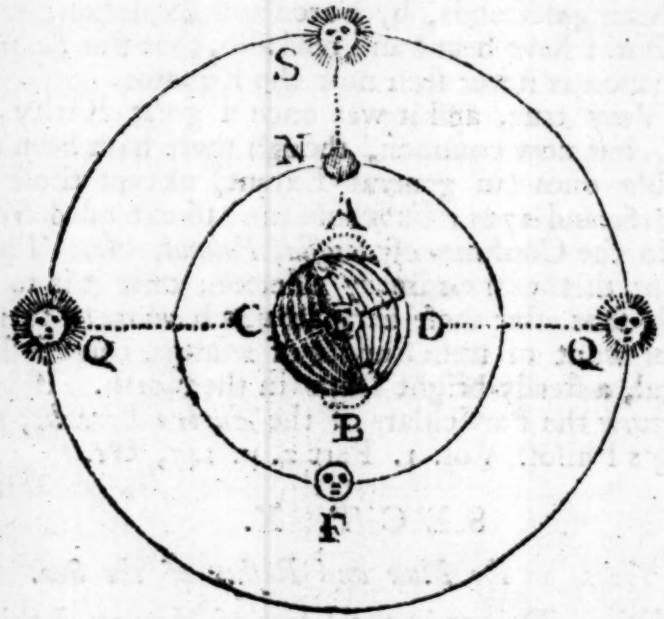
Tyr. You ſay the Cauſe is known; pray be ſo kind then as to tell me the Reaſon of the Ebbing and Flowing of the Water.

Phil. Tides are undoubtedly cauſed by the attractive Power of the Sun and Moon upon the Waters of the Ocean; but more particularly by the attractive Force of the Moon.

Tyr. I wiſh you would demonſtrate a little more to me by ſome Scheme or Figure.

Phil.

Phil. I will. Let E be the Earth, A B C D the Surface of the Water round the Earth: Let alſo N F



repreſent the Orb of the Moon round the Earth, N New Moon, F Full Moon, S Q Q the Sun in different Poſitions.

Now obſerve, 1. When the Sun and Moon are in Conjunction, *viz.* S N, theſe two Powers or Forces will attract or draw the Water upon the Surface of the Earth above, or beyond its common Courſe or Order, and cauſe it to riſe up as high as A, which will be the higheſt Tide of all, commonly called a *Spring Tide.* 2. When the Moon is at the Full at F, then the Earth will be between the Sun and Moon, (that is, the Moon is in Oppoſition to the Sun) and there will be another *Spring Tide* riſing or ſwelling to B, but not ſo high, you ſee, from the Surface as at A. Laſtly, When the Sun is in his Quadratures Q or Q (*viz.* a Quadrant or one Quarter of a Circle from the Moon) then the attractive Power of the Sun takes off Part of the attractive Force of the Moon, and therefore at C and D there will be the leaſt neap Tide of all.

Tyr. I am highly obliged to you, *Philomathes*, for it appears quite ſimple and natural to me; but yet I do not immediately

immediately know what you mean by the leaſt neap Tide.

Phil. The Reaſon why I call it the leaſt neap is, becauſe all Tides which happen between A C or A D, or between B C or B D, are called neap Tides; thoſe at A and B being only Spring Tides.

Tyr. I underſtand you, Sir; but pray do theſe Spring Tides happen always upon the Day or at the Time of New and Full Moon?

Phil. No; it is generally the ſecond or third Tide after; nor are the Tides at higheſt when the Moon is in the Meridian, but two or three Hours after; and the Reaſon is plain, for the Motion communicated, or the active Force of Attraction cannot fully act upon Waters in narrow Rivers, and in ſhoally Places; therefore do not come or flow regular and full in ſuch Places juſt at that Time: So for the ſame Reaſon the greateſt Tides, as was ſaid before, are not immediately at the Time of Conjunction or Oppoſition; for in the Ocean, or in any wide Sea or deep and extenſive Waters, the Tides ebb and flow very regularly; for it is evident, that in the great *Pacific Ocean*, they exceed both in Largeneſs and Regularity thoſe in the *Atlantic*, and in the *Atlantic* they exceed others in more narrow Seas, *&c.* for it is ſooner high Water in ſome Places than others, and it is plain that the Water riſes in ſome Rivers or Places, while it falls in others. For Inſtance, it is high Water on the Coaſt of *Portugal*, *Spain*, and the Weſt of *Ireland*, much at the ſame Time, (tho' it is not till two or three Hours after the Moon has paſſed the Meridian) by the Water flowing from the Weſtern Ocean, and the *Mediterranean* Sea; from which there iſſues two large Currents of Water, one of which paſſes South of *England*, and the other North of *Scotland*; and in theſe Tracts they naturally empty themſelves into the large Channels, and theſe again into the ſmaller ones, and theſe laſt into the inland Rivers, *&c.* from which it plainly appears, that the Tides muſt be later in the Day in ſome Parts than in others, according to the Diſtance of ſuch Rivers from the Sea, and in Proportion to their Narrowneſs, Windings and Turnings, *&c.* 2dly, It alſo is evident, that while theſe Channels and Rivers

are

are filling, by the Time they are full Tide the Moon has paſſed or advanced yet farther from the Meridian; but, however, this being once known, the Certainty of calculating high Water at any Place becomes very natural and eaſy, as was ſhewn before. 3dly, It is therefore very natural to conceive, that the Water falls in ſome Places while it riſes at others; and as it takes upwards of twelve Hours between Tide and Tide, 'tis eaſy to conceive that while the Waters are returning from the various Channels and different Rivers, there will be another new Tide or full Water at Sea, which meets with or repulſes thoſe ſmaller Currents, and forces them back again with Order and Conſtancy daily, only ſomewhat later, as was ſaid before, becauſe the Moon comes later to the Meridian.

Tyr. I am highly obliged to you, indeed, kind *Philomathes*, and I'm very well ſatisfied.

Phil. I own I have given you but a ſhort Account of theſe Things.—If you would know every Thing relating to them, you muſt conſult Sir *Iſaac Newton*, Dr. *Harris*, *Rowning* and *Martin*, as alſo the Phil. Tranſ.

SECT. XI.

Of the conſtituent Parts, and different Strata or Layers of the Earth.

Tyr. What does the Earth in general conſiſt of?

Phil. What it contains at a very great Depth or near the Center is, and muſt be, for ever unknown; but the great Dr. *Halley*, with many others, ſuppoſe, (and that very probable) that in and about its Center there are large Quantities of, or one large Maſs of *magnetic* Matter, called the *Loadſtone*. However, thus far is known, that there are vaſt Caverns, and Numbers of Receſſes for Reception of Water, and no doubt but many Rivers, which feed the other ſmall Channels, and by a Number of Conveyances are carried from Place to Place in conſtant and due Order, as the Waters upon the Surface, ſome very deep and others more fleet, and ſo near the Surface as to break forth from thence continually, ſome in great, others in ſmall Quantities of running Water, properly called Springs, *&c.*

Tyr.

Tyr. What does the more ſolid Parts chiefly conſiſt of?

Phil. There we find Variety of different Sorts of Strata or Soil; for within a few Fathom deep in ſome Places, and but a few Yards deep in others, are found four or five various Sorts of Earth, ſuch as *Clay*, *Gravel*, or *Sand*, *Loam*, *Marl*, or fat *Clay*, then black rich *Earth*, then red *Earth*, *Chalk*, *Coals*, &c. and perhaps the ſame over and over again, ſome Strata or Veins running perhaps but a Foot or a Yard deep, and for Miles in Length and Breadth; others 10, 20, or 30 Feet or Yards deep, and of leſs Extenſion; but as the conſtituent Parts are known very little more than 400 Feet deep, how then can we pretend to account for the Variety of the Strata, and of the ſalt, nitrous, and ſulphureous Matter and Subſtance, between the Surface and the Center, to the Depth of about 4000 Miles?

Tyr. Very true, *Philomathes*; but cannot you indulge me ſo far as to give me your Opinion what is the Cauſe of *Vulcano's*, *Exploſions*, and *Earthquakes*.

Phil. I cannot deny you, *Tyro*, you aſk with ſuch a Deſire of being improved.

SECT. XII.

Of VULCANO'S *and* EARTHQUAKES.

Tyr. What is a *Vulcano?*

Phil. A burning Mountain, which continually emits, or as it were, vomits Fire, and ſometimes breaks with a moſt hideous Noiſe, and ſends forth or vomits liquid Fire, throws up vaſt Quantities of red hot Stones, and ſuch Clouds of Smoke and Aſhes, as even to darken the Sky and cover the Earth for Miles round.

Tyr. Then I perceive that *Vulcano's* are not only kindled by theſe Combuſtibles, but are actually fed by them. How terrible muſt it be!

Phil. You would much more think ſo, did you ſee or live near any of them, but eſpecially *Veſuvius* and Mount *Ætna*.

Tyr. Can you farther indulge me to let me know what Part they are in, and what has been ſaid of them.

Phil.

Phil. I will. *Veſuvius* is a large burning Mountain, ſituate within ſix or ſeven Miles of *Naples* in *Italy*; I ſhall rather chuſe to ſpeak of ſome Events and Viciſſitudes that this *Vulcano* has undergone.

Tyr. I'm obliged to you, Sir; and pray where is *Ætna* ſituate?

Phil. Mount *Ætna* is ſituate on the Eaſt Side of the Iſland of *Sicily*, and is a very high and burning Mountain, which made the Inhabitants call it *Monte Gibello*, the Mount of Mounts. Its Diſtance or Aſcent from *Catanea* is about 30,000 Paces, or nearly 29 Miles. It is of a circular Form; the Circumference at the Bottom is about 100,000 Paces, or nearly 95 Miles, and its Height upwards of two Miles. It has had many Eruptions, *viz.* in 1169, 1329, 1408, 1444, 1447, 1536 and 37, 1554, 1669, 1693, and a very large one in 1753.

Tyr. Was there not great Damages none in theſe Eruptions?

Phil. Yes, in all of them; but according to the beſt Hiſtorians, the moſt diſmal of all was *that* in 1693, when there iſſued out from it a moſt dreadful Torrent of liquid Fire (which is more common to *Veſuvius*) and burning Matter which broke forth with a moſt hideous Noiſe, cauſing the Earth round it to ſhake moſt terribly, and the Devaſtation was ſo great before it ceaſed, that it entirely deſtroyed 15 or 16 different Towns, 18 Eſtates, and upwards of 90,000 Souls.

Tyr. This was ſuch a terrible Thing to the Inhabitants, that I cannot help ſhuddering at the very Thoughts of ſo diſmal a Scene.

Phil. It is very true; but how eaſy is it for us to forget the Misfortunes of others; and though we live in an Iſland, perhaps the leaſt remarkable or leaſt known to be ſubject to Calamities of almoſt every Sort, yet you will find more Diſcontent and Murmuring, and particularly more Unthankfulneſs and Ingratitude to their merciful Creator and Preſerver, than you will find in any Nation perhaps under the Sun, when the different Circumſtances of Want, Pain, Sorrow, Grief, and Sufferings are rightly put together.

Tyr.

Tyr. It is too true, indeed, *Philomathes.* But however, let me aſk you a Queſtion: Are not *Earthquakes* in general produced from the ſame Cauſe as *Vulcano's*, by *ſulphureous Damps*, *nitrous Matter*, and *mineral Coruſcations* or Fire, ſhut or pent up in the Earth?

Phil. No doubt of it, and when they cannot have Vent, the Earth muſt more or leſs ſhake to ſuch a certain Depth or Breadth as the Quantity or Force of ſuch Combuſtibles conſiſt of, or are more or leſs agitated. Thus it happens, you have Earthquakes on a ſudden with an Exploſion, which ſometimes providentially break in uninhabited Parts, and only ſhake or cauſe the Earth to tremble for a Moment or two in ſuch Places as are inhabited. At other Times we have, as it were, a ſilent Earthquake, that is, a Shaking only; and this is attended with great Danger, for when theſe fiery and agitated Bodies cannot break through the Surface, they ſometimes drive or tear away vaſt Quantities of Ground near the Surface, by which means, the Surface itſelf, with all the Inhabitants on that diſmal and unhappy Spot, ſink down ſuddenly to unknown Depths, and muſt be unavoidably buried in Ruin and Deſtruction. But I think we have dwelt long enough upon ſo ſolemn a Subject, and ſhall only add this, that though theſe Things are produced by natural Cauſes, or the Courſe of Nature, it gives no Room at all for the Deiſt, Atheiſt, or Prophane of any Sort, to ſport with, and laugh at, the Timidity of the more thinking Part of Mankind; ſince it is evident it is good to conſider, that theſe natural Cauſes are firſt acted upon by a ſupernatural Hand, and therefore to have proper Thoughts upon, and pay a reverend and due Regard to the Creator and Diſpoſer of ſuch Events, in and at ſuch a Time in particular, cannot be bad; and if it is an Error, it is an Error on the right Side (as the common Saying is) and therefore, *Tyro*, let us venture to ſet our Timidity at all ſuch Times againſt their Temerity; let them laugh at us, and let us pity them.

Tyr. Sir, I thank you for your kind Inſtruction; and have you now any Thing elſe you can communicate to me worthy of Notice?

Phil.

Phil. Yes; as I have told you of the Earth's terrible Productions, I think I ought to preſent you with ſome more agreeable.

SECT. XIII.

Of other conſtituent Parts and Productions of the Earth, viz. *Foſſils, Minerals, Ores, Stones,* &c.

Tyr. What are *Foſſils?*

Phil. The extenſive Meaning of the Word *Foſſil* ſignifies every Thing that is dug out of or hid in the Earth, ſome of which are neither inflammable or ſoluble, others are ſo. Dr. *Hill* divides them into three Claſſes, *ſimple*, *compound*, and *metallic*, which comprehends all Minerals, Ores, *&c.* but we ſhall ſpeak of thoſe by themſelves; therefore,

1. *Of* FOSSILS.

Tyr. Is not Salt a Foſſil?

Phil. Yes, and there are many Sorts, but all may be reduced to three Sorts, two of which are volatile, *viz.* acrid, which are hot and bitter; the third is lixivious, or drawn from Aſhes. Of theſe in Order. 1. *Allum*, or *Roch Allum*, is a Foſſil Salt or white Mineral, ſeparated firſt from the Earth by waſhing it with Water. Our *Engliſh* Allum is in very large Lumps, clear and tranſparent: In *Yorkſhire* it is made of a Sort of blue Stone, with Urine and Sea-Weed. There are other Countries which produce this Foſſil, as *Leige*, *Conſtantinople*, and *Italy*, of which it is ſaid this laſt is the beſt of all. 2. *Borax*, a Salt prepared from the Evaporation of Water, which runs from Copper Mines in *Bengal* and other Parts of the *Indies:* There is another green coloured Sort found in the Veins of Braſs, Silver, or Gold Ores. 3. *Eſſential Salt* is natural Salt between, or partaking of the Quality both of a *fixed* and *volatile* Salt; it is extracted or obtained from various Plants, from *Cryſtallization*, or Combination of the ſaline Particles. 4. *Foſſil Salt* (called a *Sal Gem*) is dug out of ſeveral mountainous Places in *Poland*, *Catalonia*, *Ruſſia*, *Perſia*, *&c.* it is very tranſparent and very like our common Salt. 5. *Fixed Salt* is that which is not rarified, nor will not eaſily paſs off by Exhalation, but remains fixed after Calcination,

Calcination or paſſing through the Fire. 6. *Volatile Salt* is contrary to the fixed Salt, for this riſes in Heat, and flies off inſenſibly in Steam or Vapour; ſuch are the Salts of ſome Vegetables and Animals. But to give you a clearer Idea, this is ſufficient; thoſe ſalt Particles that fly off in Steam or Vapour are called *Volatile*, thoſe that ſink or are found at the Bottom, are called *Fixed*. 7. *Nitre* or *Salt-Petre* is a cryſtalline, pellucid, whitiſh and bitteriſh *Salt*, generated from Urine falling on Stones, and is ſometimes found in or under old ruinous Buildings: When it is found in this crude State it has no Acidity; but having paſſed through the Operation by Fire, it becomes both acrid and acid; being impregnated with a Quantity of Spirits out of the Air, it becomes partly *volatile* and very ſtrong; and being mixed with Sulphur in the Air and agitated, it is this Spirit that kindles, or burſts into a Flame in Lightning, *Gunpowder*, &c. 8. *Sal Ammoniac*, a volatile Salt of two Sorts, *natural* and *artificial*. The *natural* is found in *Lybia*, and many Parts of *Africa*; the artificial is brought from *Egypt*, and is made of the Soot of Tufts, Dung of Animals ſublimed; ſome alſo is brought from *Venice*. 9. *Tartar* or *Salt of Tartar*, is a hard Subſtance, which adheres to the Sides of Wine Caſks; it is ſeparated from the Liquor by Fermentation, and ſome is of a white or lightiſh Colour, and ſome reddiſh; the White, if good, is eſteemed the beſt. 10. *Sulphur* is commonly taken for, or called by the Name of *Brimſtone*; but there is a ſenſible Diſtinction; for though all *Brimſtone* is *Sulphur*, or ſulphureous, yet all *Sulphur* is not *Brimſtone*; *Sulphur* however is well known to be an inflammable *Foſſil*; it is both *native* and *factitious*, and is found in ſeveral Places, particularly in *Sicily*. The *Native* is of ſeveral Sorts, *viz.* grey, red, and green; the *Artificial*, made from the *Native* or groſs grey Sort, is generally made up in Rolls, of a pale *yellow*, and then it is called *Brimſtone*; beſides, the *Native* is like a Clay, very ſubject to crumble and take Fire; but the Yellow or *Brimſtone* has very little Earth, but contains much Oil, and an acid vitriolic Salt. It melts with a ſmall Heat, very ſoon takes Fire, burns away with a moſt excellent fine Blue, but a very ſtrong and noxious Scent. There is another Sort of

a fine Red, like Cinnabar, very tranſparent, but is ſo ſcarce and rare, as to be known no where at preſent but in or near the Gold Mines of *Peru*. The Green is the hardeſt of all, and is found only about Mount *Veſuvius*.

OBSERVATIONS.

I am not willing, *Tyro*, to leave this Subject upon *Sulphur* without telling you ſomething further that may be of Service: And, 1. *Sulphur*, among Chemiſts, or in Chemiſtry, does not mean *Sulphur* itſelf, or *Brimſtone*, but all *oily*, *reſinous*, and *fat* Subſtances, whether of Animals or Vegetables. 2. *Sulphur* is of excellent Uſe and Service in many Reſpects. Firſt, In the Compoſition of making Gunpowder. Secondly, In whitening Silks, Woollen Stuffs, and Flowers, by the Fume or Vapour. Thirdly, The Vapour of *Sulphur* and *Brimſtone* will even act upon the Feathers of Animals; ſeveral Crows, Rooks, and other Black Birds have been made perfectly white by it, and have paſſed for Nature.

N. B. Though trifling, yet it may not be amiſs to inform the Ignorant, that it is common in *London* to waſh old Walnuts, and rub them over with *Sulphur* or *Brimſtone*, to imitate Nature and deceive the Buyer.

3. *Sulphur* is acknowledged by *all* the Writers upon, and by *all* the Practitioners in Phyſics, to be of excellent Uſe; ſo much indeed, that its Virtues are not really known to this Day, which, it ſeems, is on Account of its being ſo cheap and ſo common; but however, it is evident, that all the Faculty in Phyſics allow, that it is the very beſt and ſafeſt Remedy in all cutaneous Diſorders, ſuch as the Itch, or any ſcorbutic Diſeaſe ariſing in the Skin; becauſe anointing the Parts with its Flower made into an Ointment, with Pork-Lard or freſh Butter, not only ſtops the Orifices of the Puſtles, prevents the watry Liquor from tainting other Parts, but more particularly by choaking or deſtroying the *Animalcules* or living Creatures. 4. *Sulphur* is allowed to be a great Cleanſer and Purifier of the Blood, but being apt to looſen the Bowels, ſhould be uſed with Caution. 5. *Flores Sulphuris*, or Flower of Sulphur, is uſed in Medicine as a Pectoral, for healing Diſtem-

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pers in the Stomach, Lungs, &c. 6. *Balſam* of *Sulphur*, is Flower of Sulphur boiled with four Times the Quantity of Oil of Olives, till it comes to a Conſiſtence, &c. It is counted a fine Pectoral, and a great inward Healer. Some is made with Sulphur and *Barbadoes* Tar. 7. *Precipitated Sulphur*, called *Milk* of *Sulphur*, is made of Flower of Sulphur and Quick-Lime.

☞ One Thing is very remarkable in the Nature of *Sulphur*, and that is, that whoever has uſed it in any cutaneous Diſorder, it never fails to tarniſh or change the Gold in their Pockets; the Silver will look as if it were rubbed with Gunpowder, and the Halfpence will turn to a mouldy Green.

2. *Of other Sulphureous or Bituminous Bodies*, &c.

1. *Amber* is a yellow, tranſparent, gummy or bituminous Subſtance, has a reſinous Taſte and Scent, ſomewhat like Turpentine. It is found in ſeveral ſmall Currents, eſpecially near the *Baltic* Sea; there are two other Sorts, black and white, ſome ſay they are natural, others artificial; be this as it will, it is plain that the yellow Amber being rubbed, has a powerful Force of Attraction according to its Size, and will draw Straws, Feathers, Hairs, &c. at a conſiderable Diſtance, ſo as to ſtick and adhere to it. 2. *Ambergris*, or *Ambergreaſe*, is a fragant Drug of a greyiſh or Aſh-Colour; it is uſed as a Perfume or Cordial, and melts like Wax. It is a Kind of Bitumen, and found in ſeveral Parts on the Coaſt of *Muſcovy* and *India*. 3. *Arſenic*, though properly a Mineral, yet as it conſiſts of a vaſt Quantity of *Sulphur*, it is ranked under this Head: It is a great Cauſtic, Corroder or Eater of the Fleſh. There are three Sorts, *White*, *Yellow*, and *Red*; ſome ſay the *Yellow* is the natural Sort, which is found in Copper Mines, and is called *Orpiment*, from which the others are made; the *Red* is called *Sandaracha*. See *Cobalt*.

N. B. The corroſive Power of any of the Sorts of *Arſenic*, plainly diſcovers itſelf; for a very ſmall Quantity mixt with almoſt every Metal, renders it friable, and deſtroys its Malleability. Even Silver and Gold are not able to ſtand its gnawing and fretting Quality; for which Reaſon the Refiners dread it in all their Operations: As for Iron and Copper, it ſoon deſtroys; and Tin in particular, it will even calcine and ſoon reduce to Aſhes.

 4. *Aſphaltum*,

4. *Aſphaltum*, or *Aſphaltos*, is a dark purple, brittle, inflammable, and bituminous Subſtance, found in the *Aſphaltites* or *Dead Sea*, *Egypt* and *Paleſtine*; from which it is called *Bitumen Judaicum*, or *Jewiſh Pitch*. Some very credible Authors, both antient and modern, affirm, that in or near all ſuch Places, where *Aſphaltum* abounds in Quantities, no Fiſh can live, nor can even the Birds fly over the Places, without great Hazard of their Lives.

N. B. Nature, notwithſtanding theſe noxious Qualities of *Aſphaltos*, has provided for the Service of Man; for it is of great Uſe, being one of the principal Things uſed by Engravers to rub over the Face of their Plates in etching, &c. It is alſo uſed with Aquafortis, in eating out the Figure or Form of any Beaſt, Building, &c.

5. *Bitumen*, a fat, combuſtible, oily Matter, found in ſeveral Places, but particularly about *Babylon*, *Judea*, or in the Lake *Aſphaltites* or *Dead Sea*. Some Sorts are hard like Pitch, others glutinous, and ſpread like Mortar. Some Authors tell us, the *Babylonian Walls* and *Noah*'s Ark were built with this Water. 6. *Naphta* is a ſulphureous, clammy, inflammable, and bituminous Subſtance of different Colours, according to the Soil: There are great Quantities found in and about ſeveral Springs near the City of *Hett* in *Chaldea*, which the *Turks* call *Black Maſtick*. There are other Sorts found in *Italy*, *France*, *&c.* The Property is ſuch, that being once ſet on Fire, it is very difficult to extinguiſh it; Water making it burn with much more Fury. 7. *Petroleum*, or *Rock Oil*, called alſo *Oil* of *Peter*, is the moſt clear, lucid and tranſparent of all the inflammable and bituminous Subſtances. It diſtils or ouzes from the Clefts of ſeveral Rocks in *Provence*, *Italy*, *Sicily*, *&c.* cauſed, as it is ſaid, by the Force of ſome ſubterraneous Fire. It is ſo very inflammable, that when it ſtands ſtill in any hollow Part, even the very Rays of the Sun will ſet it on Fire, and a Candle carried near it never fails of ſetting it in Flames.

3. *Of the more ſolid Foſſils, ſuch as Minerals*, &c.

1. *Antimony*, a mineral Subſtance, of a metalline Nature, having almoſt all the Qualities of a real Metal, except that of Malleability; for which Reaſon it is by many

many called a *ſimple* Foſſil: It is found in Gold, Silver, and Lead Mines; but it is more common in *Tranſylvania*, *Germany*, &c. It is brittle, full of little ſhining Veins of different Colours. It fuſes with ſome Difficulty in Fire, and diſſolves in Water.

N. B. 1. *Antimony* is very valuable, being uſeful in *Specula*, or to finiſh concave burning Glaſſes, by giving them a fine Poliſh. 2. Being properly mixed with Bell-Metal, it adds to the Clearneſs of the Tone. 3. It is mixed with Tin to make it hard and white, and with Lead to make a proper Compoſition for the caſting of Letters or Types for printing. 4. Mr. *Boyle* ſays its Uſe is ſo great in *Phyſics*, that with two or three other proper Things, it is almoſt ſufficient to furniſh an Apothecary's Shop, with *Cathartics*, *Emetics*, *Diuretics*, or *Diaphoretics*. There are many Names indeed, but it is ſufficient to ſpeak only of theſe that follow. 1. *Crocus*, or Saffron of *Antimony*, called by Farriers *Crocus Metallorum*. 2. Waſhed *Crocus*, called *Vinum Benedictum*, being a powerful Emetic. 3. *Butter* of *Antimony*. 4. *Regulus* of *Antimony*. 5. *Tincture* of *Antimony*, &c. &c.

2. *Biſmuth*, or *Marcaſite*, is a hard, ſmooth, white, brittle, metallic Body, ſomewhat like Tin, and therefore called by ſome *Tin-Glaſs*; it contains an arſenical Salt, and is very dangerous to take inwardly. There are ſeveral chemical Preparations made from it, and the Flower is uſed to take Spots out of the Face.

3. *Chalk*, a Sort of mineral Subſtance, of different Colours, but more commonly white, abounding in barren and mountainous Lands; yet notwithſtanding, it is a great Improvement to Lands, by being mixt with proper Earth and ſpread upon the Surface.

Black *Chalk*, or *Ochre*, is uſed by Painters on blue Paper, being a very fine Black.

Red *Chalk*, or *Ochre*, is an indurated clayey Sort of *Ochre*, uſed alſo in painting; there is alſo a yellow Sort, commonly called *yellow Ochre*.

4. *Cinnabar*, a red, heavy, and very brilliant mineral Stone, found in Mines by itſelf, but moſt frequent in Quickſilver. Some ſay it is only Quickſilver petrified. *Vermillion* is made of it, by being reduced firſt to Powder, and then ground with a Mixture of Spirits of Wine and Urine.

5. *Coal*, or *Lithranthrax*, is a black, ſulphureous, and bituminous Mineral, dug out of the Earth, and in many Places in *England* lies in Veins, mixed promiſcu-

ouſly with other Strata, and other Places in very large Beds of great Extent and Depth. The beſt is of a deep ſhining Black, very brittle, and yet very friable, and being ſet on fire, burns to a Calx, with a Mixture of Aſhes.

III. *Of* METALS *or* ORES.

Tyr. What are *Metals?*

Phil. All ſuch ſimple Foſſil Bodies, that are capable of Fuſion, and become fluid by Fire, and when cold, coagulate, and harden into a ſolid Maſs, and for the moſt Part are malleable. Such are *Copper*, *Gold*, *Iron*, *Lead*, and *Tin*; to which ſome add Mercury or Quick-ſilver, which is called a fluid or liquid *Metal*; others do not rank it with Metals, for its Want of Malleability.

1. *Copper* is an *Ore*, found in different Mines Abroad and at Home. It is of ſuch great Service in the making of various Inſtruments and Utenſils for the Service of Mankind, that it would be ſuperfluous to ſay more of it: As to its Properties, they are, 1. Its Ponderoſity is next to that of Silver. 2. Its Firmneſs or Fixity will endure the Fire longer than that of Tin or Lead, but not ſo long as Silver. 3. It muſt arrive at that State of Ignition, or be red hot, before it fuſes or melts. 4. It is diſſoluble by *Acids*, *Alcaline*, or any nitrous Liquids or Fluids, in Salt-Water, and by the Dew, in open Air, &c. only with this Difference, *Acids* turn it *Green*, *Alkaline* turns it *Red*, and Salt in general *Blue*. 5. When fuſed with *Lead* or *Antimony*, it flies off in Vapour. 6. It is extremely *elaſtic*, and moſt *ſonorous* of all Bodies. 7. It is very melleable, and may be drawn out into ſmall Wire to a great Length. 8. One Grain only, diſſolved with 500,000 Grains of Water, will turn the whole to a pale Blue; ſo great is its *Diviſibility*. 9. *Copper* is found in great Quantities in *Sweden* and *Germany*, in which Places there are even *Mountains* of it; but it is allowed, that *Hungary* has the beſt Mines and richeſt Ore.

N. B. Braſs is made from *Copper*, by grinding calcined *Lapis Calaminaris* very ſmall, and mixing it with fine Charcoal, and then incorporating it with Water into a Maſs; then about ſeven Pounds of this Mixture mixed with about five Pounds of Copper, and put into a Wind-Furnace for about 11 or 12 Hours, will be converted into Braſs.

2. *Iron*

2. *Iron* is a very hard and brittle, yet a malleable and fuſible Metal; its Texture, conſiſting of Earth, Salt, and Sulphur, makes it very liable to Ruſt. The Properties are as follows; 1. Its Fixity is ſuch, that inſtead of fuſing before Ignition, it requires not only a cloſe Confinement in Fire before it will melt or run, but even *that* Fire muſt be well ſupplied with Wind, and the Iron be made (what the Smiths call) white, or welding hot, before it will fuſe, run, or ſeparate; and by this Means many ſmall Pieces are welded, beaten, and united together in one Maſs; and if heated to a proper Degree, will adhere to each other cloſer and better than one Piece of itſelf of the ſame Length and Size. 3. *Iron*, though made more pliable, and ductile, and more eaſy malleable by Ignition or Heat, yet it may alſo be made much harder and more brittle, by heating it red hot, and then ſuddenly immerging it in Water, which will make ſome Sorts of it ſnap like Glaſs. 4. If it be firſt heated, and then quenched in Sal-Armoniac or Quick-Lime, it will turn all the Particles of it quite white and exceeding brittle. 5. It is not only *rubiginous*, or vaſtly ſubject to contract Ruſt, either by Air, Dew, Fire, Salt, or Water, but even becomes diſſoluble in them. 6. It is very elaſtic and *ſonorous*, but not ſo much as *Copper*, except when it is made into *Steel*; then it is more *ſonorous* than *Copper* itſelf, but not ſo *ſonorous* as *Braſs*. 7. Of all Bodies none are ſo acted upon, or attracted by the Load-Stone to ſuch a Degree as hard bright Iron, or rather *Steel*; and ſo great is the Action, Power, Virtue, Force, and Efficacy of the Load-Stone over it, that it even communicates the ſame Virtue to it, eſpecially if it be poliſhed, ſo that it will become a *Magnetic*, and attract other Bodies very ſtrongly. 8. Iron is found in Mines, not only in *England*, but in *Poland*, *France*, and *Germany*; but the greateſt Ores are found in *Norway* and *Sweden*.

N. B. As *Braſs* is made from *Copper*, ſo *Steel* is made from *Iron*; for it is only Iron purified in the Fire by Art with proper Ingredients, which cauſes it to be finer, whiter, and more hard and brittle. There are two Sorts, one called bliſter Steel, made of large Bars of Iron, which have Knobs or Bliſters upon them; and this Sort is uſed for large Edge-Tools, ſuch as Spades, Cleavers, Axes, *&c.*

3. *Lead*, called *Saturn*, is a very coarſe, heavy, droſſy, and impure Metal, conſiſting of Sulphur, ſome little Mercury, and a great Quantity of black bituminous Earth. The Properties are, 1. It is the next Metal in Weight to Gold, being heavier than Iron or Copper. 2. It is the leaſt liable to Ruſt, and the leaſt elaſtic and ſonorous of all Metals, except Gold. 3. It is the ſofteſt and eaſieſt malleable Body. 4. It requires the leaſt Fire of all Metals to melt it, or put it in Fuſion, (Tin excepted) and then it appears (after the Droſs is ſkimmed from the Surface) much of the Colour and Conſiſtence of Quickſilver, rolls about in a liquified State like it, but does not ſeparate in Parts ſo much, and if ſuffered to grow cool does not paſs or run off in globular Bodies like the other. 5. Lead not only ſoon melts, being put in any Ladle or proper Vehicle over a Fire, but being continued over the Fire, ſoon becomes ignitious, and will in a ſhort Time repreſent a Body of liquid Fire. 6. Its Uſe is ſo well known for Service, in making of Ciſterns to hold Water and other Liquids, and for making of Pipes for the Conveyance of Water, *&c.* from Place to Place, that it needs no further Deſcription. 7. Lead is found in ſeveral Mines in *England*, *Germany*, and *Hungary*, ſometimes pure, but much oftner in the mineral *Ore*.

4. *Silver*, or *Argentum*, is the pureſt of all Metals except Gold, and is found in ſome Places pure, and in others in Ore, mixed with *Copper*, *Cobalt*, *Antimony*, *Lead*, *Coal*, and other Minerals; ſome of which is blackiſh, ſome brown, others grey, which is owing to the different Strata or Bodies of Earth in which it is found. Its Properties are as follows. 1. It is the next to Lead in Weight; and its Fixity, Ductility, and Malleability is next to that of *Gold*. 2. It reſiſteth the Power of Lead in Fuſion for a long Time, yet is refined by it; but when fuſed with Antimony, will, without great Care, turn to a *Scoria* or Droſs. 3. *Silver* is not diſſoluble by any Thing ſo ſoon as Aquafortis. 4. Its Fuſibility by Fire is eaſy, yet not ſo ſoon obtained as that of Lead, but melts immediately after Ignition. 5. It amalgamates with Quickſilver, and volatilizes with Antimony.

timony. 6. It is more *ſonorous* than Lead or Gold, but not ſo much as Iron or Copper, and may be drawn out into a very ſmall Wire. 7. The *Chemiſts* ſuppoſe Silver to have ſome Affinity with the Moon, and therefore called *Luna*, and mark it thus ☽, and in Heraldry it is called *Argent*. 9. Its Beauty and Uſe are known to moſt Families, and its Neatneſs and Durableneſs are ſuch, that nothing is ſo cheap in the End. 10. It is found in the Mines of *Peru*, *Chili*, &c. and it is of ſo high Eſteem with all Nations, that it is not only uſed for Decoration, Shew, and Grandeur, but even as their current Coin Abroad and at Home. 11. The Standard for Silver Coins, called Sterling Silver, in *England*, is a Mixture of 11 *oz.* 2 *dwt.* of pure Silver, with 18 *dwt.* of good Copper, and ſo in Proportion for any greater Maſs or leſs Quantity.

5. *Tin* is a whitiſh coloured, ſulphureous Metal, found blended with almoſt all Subſtances. Its Properties are, 1. It is the lighteſt of all other Metals, and the ſofteſt of all except Lead. 2. It loſes more of its Weight in Fire than any of the Metals, which ſhews that its Fixity is the leaſt of all. 3. It is melted by a leſs Degree of Heat even than Lead, for being mixed together in a Maſs, and put in any proper Vehicle under a Fire, the Tin will run or ſeparate firſt from the Lead. 4. The proper Diſſolvent of Tin is the ſame as Gold, *viz.* by *Aqua Regia*, and with Difficulty in this, but not by any other Menſtruum. 5. *Tin*, though like Silver in its Colour, and by Art may be made to approach very near to it in Likeneſs, (Weight excepted) yet it is like a common Enemy to it; for if a Maſs of Silver be mixt with but one tenth Part of Tin, it will become almoſt as brittle as Glaſs. 6. Another ſtrange Property of *Tin* is, that though it is the leaſt *ſonorous* of all Metals except Lead, yet mixed with any of them, according to Art, greatly adds to the Clearneſs of the Sound. 7. It is alſo the leaſt elaſtic of all except Lead, yet being mixed with others increaſes their Elaſticity. 8. Tin-Ore is a heavy, ſpungeous Sort of Stone, principally found in *Cornwall*, *Devonſhire*, &c.

6. *Gold*, when refined from its Ore, has the following Properties. 1. It is the heavieſt, moſt ductile, pureſt and moſt valuable of all Metals. 2. It requires very ſtrong Fire to melt it, and its Fixity is ſo great, that being melted many Times, it loſes but very little of its Weight. 3. Some ſay it is incapable of Ruſt, but it is known the Fumes of Sea-Salt will ruſt or canker it. 4. It amalgamates with Quickſilver the moſt readily of all Metals. 5. It will remain in the Fire for Days and Days melted, and being taken out will afterwards be found to loſe nothing of its Weight. 6. It is of ſuch ſurprizing Ductility, as Dr. *Halley* tells us, that one Grain of it will gild ninety-eight ſquare Yards; and Mr. *Boyle* ſays, one Grain and $\frac{1}{4}$ may be beaten out into an Area upwards of fifty Inches ſquare, and that one Ounce only may be drawn out into a Wire 274,500 Yards long, *viz.* near 156 Miles in Length. It is diſſoluble in no other Menſtruum than *Aqua Regia*, with ſome ſmall Quantity of Mercury. 8. It is found in Ore or in Duſt in ſome Parts of *Guinea*, *Chili*, *Peru*, &c.

7. *Of Mercury or Quickſilver.*

Mercury is not allowed by ſome to be a Mineral, but it is called in general a Semi-Mineral, and by all a Fluid. Its chief Properties are, 1. It is the heavieſt of all Bodies except Gold. 2. It is the coldeſt to the Touch of all Bodies, and yet ſome Degree of Heat given to the Waters, ſo as to make it juſt hot, will be ſufficient to make the Mercury burn the Fleſh ſeverely. 3. Its Parts may be ſeparated more to the naked Eye than any other Body, the Diviſibility being apparent at any Stroke or ſudden Preſſure; a Piece, or rather one ſmall Drop or Globule, may be ſeparated into 100,000 viſible Parts. 4. It paſſes off in Vapour almoſt as thin as the very fineſt Air, and yet it is pure Mercury ſtill, and may be united. 5. It is quite volatile, and penetrates the Parts of other Bodies, making them brittle. 6. It diſſolves in a ſtrong acid Menſtrua, and alſo indifferently in *Aqua Regia* and Aquafortis. 7. Its Fluidity is ſo great, that it never congeals nor freezes. 8. The Ores of Mercury are various, the general ones are called

ed *Cinnabar*, found in many Mines in *Italy*. 9. There is alſo pure or *Virgin* Mercury, which is found running in ſeveral Cavities or Veins in the Earth. 10. Its Uſe in Phyſic is well known, and its Power and Force are ſo great, that if given, or taken by unſkilful Hands, it is preſent Death to ſome, and never fails to bring on a Ptyaliſm or Salivation, with trembling of the Nerves, and almoſt all Diſorders.

IV. *Of* Stones.

There are ſo many Sorts of Foſſils under this Denomination, that it would require a large Treatiſe to explain their different Texture and Uſes. We hope therefore our young *Tyro*'s will be ſatisfied, if we ſpeak only of the coarſer Sort in general, and the more fine and valuable in particular.

1. *Of the coarſer or common Stones.*

Of theſe there are five Sorts. 1. The common Stone of various Sorts and Sizes, found in Gravel or on the Surface of the Earth in every Place. 2. *Chalk Stones*. 3. *Pebbles* and other Stones uſed for Pavement. 4. *Portland* Stone. 5. *Flint* Stones, both uſed for Buildings; the laſt of which is ſo extreme fine that it is called the *Engliſh Agate*, and ſome Sort is ſo fine, after its being poliſhed, that it is even ranked in the Order of Gems. No Stone will produce ſo much Fire as the black Flint when ſtruck againſt hardened Iron or Steel, for which Reaſon it is not only uſed in Families, but cut into a proper Size for Guns; its Uſe alſo in the making of Glaſs is ſo great and well known in general, that little more can be required to be ſaid concerning it.

2. *Of the finer Sort of Stones*, viz. *Alabaſter*, *Porphyry*, *and Marble*.

1. *Alabaſter*, a fine Stone, ſomewhat like Marble, but much ſofter, and not ſo veiny or brittle. The beſt Sort is found in *Egypt* and alſo in *Cornwall*; being excellently variegated with Veins of a pale red, whitiſh or brown Colour, upon a very fine and clear pale yellow Ground. It is uſed in ſmall Statues, Vaſes, and Columns; and cuts exceeding ſmooth. It is ſometimes re-

duced to Powder, then mixt with Water, and uſed like Plaiſter of *Paris*.

2. *Porphyry* is alſo a Sort of *Marble*, of various Colours; but that of the browniſh red Colour is called the beſt. It is ſo exceeding hard, that few Tools will cut it, and alſo is very difficult to calcine. It is found in *Egypt* in immenſe *Strata:* Alſo in *Arabia*, *Germany*, *England*, &c. but that found in the Iſland of *Minorca* is ſaid to be ſuperior to all the *Italian* Marble.

3. *Marble*, a very hard, fine, and curious Stone, found in the Quarries of *Italy*, *England*, &c. and many other Places. It is much harder than *Alabaſter*, but not ſo hard as *Porphyry*. There are fourteen Sorts, ſome of which are white, brown, red, green, black, blue, yellow, veined, and variegated beyond the Power of Man to deſcribe; but the *Italian* Marble, called *Brocatella*, is counted the fineſt, being red, variegated with white and gold Veins. It bears an exceeding fine Poliſh, and its Uſe and Beauty in Buildings, and raiſing Monuments, are well known.

3. *Of the ſmaller and more precious Stones, in alphabetical Order.*

1. *Adamant*, (or *Diamond)* is not only the hardeſt, but the moſt precious of all Gems; there are ſeveral *Adamants* of various Colours, *viz.* darkiſh green, Cryſtal, *&c.* but the Cryſtal being the moſt pellucid, ſhining and tranſparent, is counted the beſt. The real *Adamant* has an electric and attractive Quality, and in Hardneſs far exceeds all other Bodies; for nothing will cut *Adamant* or *Diamond*; nay, even the beſt hardened Steel will not cut common Glaſs, which *Adamant* cuts with Eaſe and Pleaſure.

As there are ſeveral *Gems* taken for *Diamonds* in Appearance, it is by this Property of cutting other Bodies that the *Adamant* or *Diamond* is truly known and diſtinguiſhed. See the Word *Diamond.*

2. *Agate* or *Achate*, is a ſemi pellucid *Gem* of various Colours, *viz.* white, (called the *Nocoa Stone)* red, green, and yellow; ſome of them when cut are full of Veins, which repreſent Animals, Trees, Rivers, *&c.* and though an opake Stone, yet have a fine and beauti-

ful

ful Surface, and ſhines very much by a ſtrong reflected Light.

3. *Amethyſt*, a precious Stone or Gem, of a purple Colour in general, but yet is ſometimes compoſed with, or tinged or mixed with a pale red, deep red, or violet; but when found colourleſs, or by being made ſo by paſſing through the Fire, it then becomes very pellucid, and equal in value to the Ruby and Sapphire; and it muſt be a Perſon of no ſmall Judgment, to diſtinguiſh it from a Diamond. They are found in ſeveral Parts of *Europe*, but thoſe of the Eaſt and Weſt *Indies* are the beſt, being the hardeſt and moſt pellucid. It was the laſt in the third Row of *Aaron*'s Breaſt Plate.

4. *Beryl*, is a pellucid Stone, of a pale green Colour, ſomething of the Nature of a Cryſtal. It is found about the Gold-Mines of *Peru*, alſo in the Earth at the Foot of Mount *Taurus*, and in the *Euphrates*, ſometimes in a Pebble-like Form, at others in hexangular Columns, terminating in hexangular Pyramids. Its Hardneſs is very near the *Garnet*, and its Size from a ſmall Pear to a Walnut. It was the firſt Stone of the fourth Row in *Aaron*'s Breaſt-Plate, on which was engraved *Naphtali*.

5. *Beryl Cryſtal*, called by the Lapidaries the *brown Cryſtal*.

6. *Carbuncle*, a precious Stone of a ſcarlet or fiery Colour. It is in Hardneſs about the ſame Degree of the Sapphire, and found in general in angular Forms, about the Size of a Horſe Bean. It bears the Fire without altering, and being held up againſt the Sun, looks like a burning Charcoal. It is found in the Eaſt *Indies*. It was the laſt Stone in the firſt Row in *Aaron*'s Breaſt Plate.

7. *Cornelian*, a Species of the *Sardonyx*, is a ſemi-pellucid Stone, of a reddiſh Colour, pretty hard, clear, and free from Spots, found in the Eaſt *Indies* and other Places. This Stone is moſtly uſed for Seals.

8. *Chalcedony*, a ſemi pellucid Gem, variegated with different Colours, which reſemble ſo many white Clouds. The bluiſh *Chalcedony* is reckoned the moſt valuable, and is now ranked among the ordinary Sort of Agates, and is uſed for Seals, and often engraved with Coats of Arms,

Arms, &c. It is uſed alſo to make Vaſes, ſmall Cups, Crucifixes, and Beads. All the Sorts readily ſtrike Fire with Steel.

9. *Chryſolite*, is a precious Gold-coloured Stone, mixed with green, which gives it an exceeding fine Luſtre. It was the firſt Stone of the third Row in *Aaron*'s Breaſt-Plate. It is called by the Jewellers a *Topaz*. It is found in *Sileſia*, *Bohemia*, and *New-Spain*, in irregular pebble Forms, never columnar, and ſeldom larger than the Size of a Nutmeg.

10. *Chryſophraſus*, a Species of the *Praſius*, of a pale but pure green Colour, and is one of thoſe mentioned in *Revelations* Chap. xxi. Ver. 20.

11. *Cryſtal*, a very fine pellucid and tranſparent Stone, reſembling a Diamond, but being much ſofter, has not that Luſtre. *Cryſtal* is found on the Top of high Mountains, in various Places and different Shapes; ſome being columnar, with double Pyramids, others pentangular and hexangular, *&c.*

12. *Diamond*, (ſee *Adamant*) the moſt precious, pellucid, and valuable of all Gems. They are found in the Iſle of *Borneo*, and in ſeveral other Places in the Eaſt and Weſt *Indies*, in various Sizes and Shapes, but generally very ſmall, the largeſt (which ſeveral Authors agree is not ſo large as a Walnut) is ſaid to be in the Poſſeſſion of the *Great Mogul*; it weighs about 280 Carats, and is worth about 780000 Pounds Sterling.

13. *Emerald*, (or *Smaragdus*) a precious, tranſparent Stone, of a fine green Colour, and next in Hardneſs to the Ruby, and for Beauty none exceeds it. This Stone is found both in the Eaſt and Weſt *Indies*, in various Shapes and Sizes. It was the firſt Stone in the ſecond Row in *Aaron*'s Breaſt Plate.

14. *Hyacinth*, or *Jacinth* (*Rev.* Chap. xxi. Ver. 20.) is a precious Stone, of the Carbuncle Sort, of a fine red Colour (like to the Flower of the ſame Name) but has not that Luſtre, nor appears ſo ſtriking to the Eye as Gems in general. The Jewellers divide them into four Sorts, viz. 1. *Hyacinthala Belle*, a Sort of Flame or faint red mixed with yellow. 2. *Amber Hyacinths*, mixed with a light yellow and red. 3. *Saffron Hyacinth*,

is

is partly yellow and red, but not clear; and, 4. A *Rubacella*, which is a fine deep red, mixed with yellow. The firſt of theſe is found in the Eaſt and Weſt *Indies*, the laſt only in the Eaſt *Indies*.

15. *Jaſper* was formerly reckoned among the precious Stones, as appears from its being ranked with them in *Rev.* Chap. xxi. Ver. 19. but the Moderns count it only a ſemi-pellucid Stone at beſt, and very little better than the fineſt Marble, though it is harder, and will bear an excellent Poliſh. It is a Stone of various Colours, but the Green, called *Lapis Divinus*, is the moſt common, which is found in ſeveral Parts of the Eaſt *Indies*. There are others of various Shapes, and as for Size, they run from two Inches to a Foot Diameter. It was the laſt Stone in the fourth Row of *Aaron*'s Breaſt Plate.

16. *Onyx*, a Sort of a ſemi-pellucid Gem, the Colour of the human Nails, having Zones of various Colours, but not red, and though compoſed with a Sort of Jaſper, debaſed with Earth. The higheſt coloured Sort is found in the *Red Sea*, the more dark Sort in ſeveral Parts in and about *Babylon*. It was the ſecond Stone in the fourth Row of *Aaron*'s Breaſt Plate.

17. *Praſius*, is a Sort of an Emerald, but not ſo hard, and of a coarſer green.

18. *Ruby*, a very precious Gem, of a fine red Colour, mixed ſometimes with a yellow or purple. When it is found pure, it is of very little leſs Value than the *Diamond*, and very near as hard. It is alſo called *Sardis*, from a Place of that Name in *Lybia* in *Aſia*, where the pale Sort is found. It is ſuppoſed to be the firſt Stone of the firſt Row in *Aaron*'s Breaſt-Plate.

19. *Smaragdus*. See *Emerald*.

20. *Sapphire*, a precious pellucid Gem, of a fine blue. The deepeſt blue Sort is counted the beſt, and is in Value next to a *Diamond*. They are found in various Forms and Sizes in *Pegu* and many other Places in the *Indies*, alſo the Iſle of *Ceylon*, *&c.* It was the ſecond Stone in the ſecond Row in *Aaron*'s Breaſt Plate.

21. *Sardonyx*, a precious pellucid Stone, of a pale red Colour, a Sort of a Mixture of the Ruby and the Onyx. Some reckon four Sorts, *viz.* 1, The red *Sardonyx*, variegated

variegated with the *Onyx*. 2. The broad-zoned *Sardonyx*. 3. The horny *Onyx*, with white and yellow Zones; and, 4. The light bluiſh *Sardonyx*, with yellow or orange-coloured Zones. The *Cornelians* are comprehended in the firſt Sort.

22. *Topaz*, a precious pellucid Gem, of a curious green Colour, like the *Emerald*; but others ſay it is of a fine yellow, and for that was called *Chryſolite*. Theſe Gems run ſo very ſmall, that they are ſeldom found larger than a Pea. It is equal to the Ruby in Hardneſs, and in Value next the Diamond. They are found in the Eaſt *Indies*, alſo *Bohemia*, *Sileſia*, &c. It was the ſecond Stone of the firſt Row in *Aaron*'s Breaſt Plate.

Thus, *Tyro*, I have endeavoured to give you a ſhort Account of the moſt beautiful Stones and Gems. If your Curioſity ſhould lead you farther after *Foſſils*, &c. I refer you to Nature Delineated, or Philoſophical Converſations, tranſlated from the French of *Abbe Le Pluche*, wherein the wonderful Works of Providence in the animal, vegetable, and mineral Creation are laid open in the moſt curious and entertaining Manner, in four Vols. 12mo. with a great Variety of Copper-Plates, curiouſly engraved.

THE

THE

YOUNG MAN's Book of Knowledge, &c.

PART IV.

OF

GEOGRAPHY.

Tyro. WHAT do you mean by Geography?

Phil. Geography teaches the Properties of the Earth, in Reſpect both to Land and Water; as alſo the different Situation and Diſtance in Reſpect of each other.

Tyr. Into how many Parts is the Earth divided?

Phil. Into many, but all are contained under four Heads called Quarters.

Tyr. What are the Names of theſe four Quarters?

Phil. They are called, 1. *Europe*, 2. *Aſia*, 3. *Africa*, and 4. *America*.

Tyr. What are the other nominal Parts of the Earth; or how is it yet further divided in Relation to Land and Water?

Phil. Into ten different Names; five belonging to the Diviſion of Land, *viz.* 1. A Continent. 2. An Iſland. 3. A Promontory or Cape. 4. A Peninſula. And 5. An Iſthmus. And theſe anſwer to the next five belonging to the Water, *viz.* 1. An Ocean. 2. A Lake. 3. A Bay. 4. A Gulph. And 5. A Streight. Theſe anſwer to each other (as was ſaid before) as more plainly appears by the following Deſcription.

LAND.

LAND.

1. A Continent is a large Tract, or vaſt Extent of main Land, not ſeparated by any Ocean. Thus *Europe*, *Aſia*, *Africa*, &c. are Continents.

2. An Iſland is a Tract of Land ſurrounded with Water; as *Great Britain*, *Ireland*, *Madagaſcar*, &c.

3. A Promontory, or Cape, is a Portion or Part of Land running far into the Sea; as *Cape Verde*, *Cape of Good Hope*, &c.

4. A Peninſula is a Part or Portion of the Earth almoſt ſurrounded with Water, ſave only a narrow Part or Neck of Land which ties or unites it to a Continent; as *Africa* itſelf, *Jutland*, &c. &c.

5. An Iſthmus is a narrow Part of Land, by which a Peninſula is joined to a Continent, or Main-Land; as the Iſthmus of *Panama*, which joins *North* and *South America* together; the Iſthmus of *Corinth*, &c.

WATER.

1. An Ocean (or Sea) is a large Extent or Collection of Waters, free from Land; ſuch as the *Atlantic* or *Weſtern Ocean*, the *Indian Ocean*, &c.

2. A Lake is a Tract of Water, ſurrounded by Land; as the Lake of *Geneva*, the *Dead Sea*, the *Caſpian Sea*, &c.

3. A Bay is a Portion or Part of the Sea running far up the Main-Land; as the *Bay of Biſcay*, *Bay of Siam*, &c.

4. A Gulph (or inland Sea) is a part of the Ocean almoſt ſurrounded with Land, ſave ſome Streight or narrow Gut of Water, by which it has Communication with the Ocean; as the *Gulph of Arabia*, the *Mediterranean Sea*, &c.

5. A Streight is a narrow Paſſage or Part of the Sea, which joins one Sea to another; as the *Streights of Gibraltar*, which joins the *Mediterranean Sea* to the *Atlantic Ocean*; the *Streights of Babelmandel*, &c.

SECT. II.

A further Deſcription of the four Quarters of the World; and,

I. *Of* EUROPE.

Tyro. What are the principal Kingdoms or Parts into which *Europe* is divided?

Phil.

Phil. They are nine in Number, *viz.* 1. *Scandinavia*, (which contains *Sweden*, or *Swedeland*, *Denmark*, and *Norway*.) 2. *Moſcovia*, or *Ruſſia*. 3. *France*. 4. *Germany*. 5. *Poland*. 6. *Spain*. 7. *Italy*. 8. *Portugal*. And 9. *Turkey*.

I. *Of* SCANDINAVIA.

Tyro. What do you mean by *Scandinavia*, and how, or whereabouts is it ſituate?

Phil. Scandinavia is a large Continent, ſituate between fifty-four and ſeventy-two Degrees of N. Latitude; under which Name is comprehended the Kingdoms of *Sweden*, *Denmark*, and *Norway*, as was ſaid before.

1. SWEDEN.

Tyr. How is *Sweden* ſituate?

Phil. Sweden is bounded on the N. and E. by *Norway*, on the E. by *Moſcovia*, and on the S. by the *Sound*, and Part of the *Baltick*. Its Metropolis or Chief Town is *Stockholm*, whoſe Diſtance from *London* is about twelve Degrees three fourths, *viz.* eight hundred eighty-ſix Miles N. E. The longeſt Day in the moſt northern Parts of this Country is about two Months, and the ſhorteſt in the moſt ſouthern Parts about ſix Hours and Half.

2. DENMARK.

Tyr. How is *Denmark* ſituate?

Phil. Denmark is bounded on the N. by the *Sound*, on the E. by the *Baltick*, on the S. by Part of *Germany*, and on the W. by the *German Ocean*. Its Metropolis is *Copenhagen*, whoſe Diſtance from *London* is about ſix hundred and ten Miles N. E. The Length of the longeſt Day, in the moſt northern Parts of this Country, is about ſeventeen Hours and Half, and the ſhorteſt in the moſt ſouthern about eight Hours and Half.

3. NORWAY.

Tyro. How is *Norway* ſituate?

Phil. Norway is bounded on the N. W. and S. by Part of the *Main Ocean*, and on the E. by *Sweden* and the *Gulph of Bothnia*. Its Metropolis is *Bergen*, whoſe Diſtance

tance from *London* is about nine Degrees one fourth; *viz.* ſix hundred forty-two Miles N. by E. The Length of the longeſt Day in the moſt northern Parts is above two Months, and the ſhorteſt in the moſt ſouthern is about ſix Hours and Half.

II. *Of* MOSCOVIA *or* RUSSIA.

Tyr. How is *Moſcovia* ſituate?

Phil. Moſcovia is bounded on the N. by the great *Northern Ocean*, on the E. by *Tartary*, on the W. by *Sweden*, and on the S. by the *Caſpian Sea*, and Part of *Little Tartary* and *Georgia*. Its Length is computed to be about one thouſand two hundred and fifty Miles, and Breadth about one thouſand one hundred Miles. Its chief Province is *Moſcovy*, and its Metropolis *Moſcow*, whoſe Diſtance from *London* is about twenty-three Degrees; *viz.* is nearly ſixteen hundred Miles N. E. and about eight hundred E. of *Cracow*. The longeſt Day in the moſt northern Part of this Country is about two Months, and the ſhorteſt in the moſt ſouthern is about nine Hours and Half.

III. *Of* FRANCE.

Tyro. How is *France* ſituate?

Phil. France (called *Gallia*, or Place of the antient *Gauls)* is bounded on the N. by the *Engliſh* Channel, on the E. by *Germany*, on the S. by Part of *Spain* and the *Mediterranean Sea*, and on the W. by the *Bay of Biſcay*. Its Length is computed to be five hundred and fifty Miles, and the Breadth three hundred and eighty. Its Metropolis is *Paris*, whoſe Diſtance from *London* is about three Degrees S. S. E. *viz.* two hundred and ten Miles. The Length of the longeſt Day in the moſt ſouthern Part of this Kingdom is about ſixteen Hours one Quarter, and the ſhorteſt in the moſt ſouthern Part nine Hours one Quarter.

IV. *Of* GERMANY.

Tyro. How is *Germany* divided?

Phil. Germany is in Length about five hundred and fifty Miles, and Breadth about five hundred and ten. It

is

is divided into three Parts, *viz. Holland*, *Flanders*, and *Upper Germany*.

1. HOLLAND.

Tyro. How is *Holland* ſituate?

Phil. Holland is bounded on the N. by Part of the *German Ocean*, on the E. by *Upper Germany*, on the S. by *Flanders*, on the W. and Part of the N. by the *German Ocean*. Its Metropolis on the N. Part is *Amſterdam*, whoſe Diſtance is about two hundred and ten Miles E. of *London*; and *Rotterdam* on the S. which is about one hundred and ninety Miles S. E. of *London*.

2. FLANDERS, *or* SPANISH NETHERLANDS.

Tyro. How is *Flanders* ſituate?

Phil. Flanders is bounded on the N. by *Holland*, on the E. by *Upper Germany*, on the S. by *France*, and on the W. by the *German Ocean*. It has many fair and rich Provinces, the Metropolis of which is *Antwerp*, whoſe Diſtance from *London* is about one hundred and eighty-five Miles E.

3. UPPER GERMANY.

Tyro. What do you mean by *Upper Germany*, and how is it ſituate?

Phil. Upper Germany is Part of *Germany* itſelf, and Part of *Gallia* and *Old Italy*. It is bounded on the N. by *Denmark* and Part of the *Baltick*, on the E. by *Poland*, on the S. by *Italy*, and on the W. by *France*. Its Metropolis is *Cologne*, whoſe Diſtance from *London* is about three hundred and forty Miles E.

V. POLAND.

Tyro. How is *Poland* ſituate?

Phil. Poland is bounded on the N. by Part of *Moſcovia* and Part of the *Baltick*, on the E. by *Little Tartary* and Part of *Moſcovia*, on the S. by *Hungary*, *Tranſilvania* and *Moldavia* in *Germany*, and on the W. by *Upper Germany*. Its Length is about ſix hundred Miles, and Breadth about five hundred and ninety. Its Metropolis is *Cracow*, whoſe Diſtance is from *London* thirteen Degrees one Half, *viz.* about nine hundred and forty Miles E. The longeſt Day in the moſt northern Part of this Country is about ſeventeen Hours and Half,

and

and the ſhorteſt in the moſt ſouthern about eight Hours one Quarter.

Tyro. Is there any other remarkable Places belonging to *Poland?*

Phil. Yes, *Pruſſia*, whoſe chief Town is *Dantzick*; and *Little Ruſſia*, whoſe chief Town is *Lembourg*.

VI. *Of* SPAIN.

Tyr. How is *Spain* ſituate?

Phil. Spain is bounded on the N. by Part of *France* and the *Bay of Biſcay*, on the E. by the *Mediterranean*, on the S. by the *Streights of Gibraltar*, and on the W. by *Portugal*. Its Metropolis is *Madrid*, whoſe Diſtance is better than eleven Degrees, *viz.* about ſeven hundred and eighty Miles S. by W. of *London*. The longeſt Day in the moſt northern Parts of this Kingdom is about fifteen Hours one Quarter, and the ſhorteſt in the moſt ſouthern Part is about nine Hours one Quarter.

VII. *Of* PORTUGAL.

Tyr. How is *Portugal* ſituate?

Phil. Portugal is bounded on the N. by Part of the *Bay of Biſcay*, on the E. by *Spain*, and S. and W. by the *Atlantic Ocean*. Its Metropolis is *Liſbon*, whoſe Diſtance from *London* is better than fourteen Degrees S. W. by S. *viz.* about nine hundred and eighty Miles. The longeſt Day in the moſt northern Parts of this Country is about fifteen Hours, and the ſhorteſt in the moſt ſouthern about nine Hours three Quarters.

VIII. *Of* ITALY.

Tyr. How is *Italy* ſituate?

Phil. Italy is bounded on the N. by Part of *Germany*, on the N. E. by the *Adriatic Sea*, or *Gulph of Venice*, and on the S. and W. by the *Mediterranean* and Part of *France*. Its Metropolis is the City of *Rome*, (the Seat of Papacy, and Reſidence of the Pope, the pretended Succeſſor of St. *Peter*, and infallible Head of the Church in all ſpiritual Matters and Controverſies, as appears by the

the Articles of their Faith *) whoſe Diſtance from *London* is nearly thirteen Degrees S. E. *viz.* about nine hundred and three Miles.

☞ Here follows a brief Account of the popiſh Creed, or Articles of Faith, commonly called Pope *Pius* IVth's Creed.

Note, This Creed is divided into twenty-four Articles; the firſt twelve of which, being the very ſame as our *Nicene Creed*, I omit, and begin with their thirteenth Article.

Art. 13. 'I moſt firmly admit and embrace the apoſtolical and eccleſiaſtical Traditions, and all other Obſervations and Conſtitutions in the Church of *Rome*.'

Art 14. 'I do admit the Holy Scriptures in the ſame Senſe the holy Mother-church doth, whoſe Buſineſs it is to judge of the true Senſe and Interpretation of them; and I will interpret and receive them according to the unanimous Conſent of the Fathers.'

☞ Art. 15. 'I do profeſs and believe that there are ſeven Sacraments of the *New Teſtament*, truly and properly ſo called, inſtituted by *Jeſus Chriſt* our Lord, and neceſſary for the Salvation of Mankind, tho' not all of them to every one; *viz.* Baptiſm, Confirmation, the Euchariſt, Penance, Extreme Unction, Orders, and Marriage: And that they do confer Grace; and that of theſe, Baptiſm, Confirmation and Orders may not be repealed without Sacrilege; I do alſo receive and admit the received and approved Rights of the Catholic Church, in her ſolemn Adminiſtration of the ſaid Sacraments.'

Art. 16. 'I do embrace and receive all and every Thing that hath been defined and declared by the holy Council of *Trent*, concerning Original Sin and Juſtification.'

* As I am ſenſible the Emiſſaries of *Rome* are never wanting, by Artifice and Cunning, to gain many Proſelytes to their Perſuaſion (and eſpecially from the eſtabliſhed Church) I think this Digreſſion will not be taken amiſs by true Lovers of Proteſtantiſm and Liberty; and as it may happen, that this ſmall Tract may fall into ſuch Hands as have not yet heard of their Errors and Inconſiſtencies; if but one out of thoſe may by this Means be prevented from falling a Sacrifice to their pernicious Principles, it will both anſwer my Deſign and their Welfare.

☞ *N. B*

☞ *N. B.* Art. 17. 'I do alſo profeſs that in the 'Maſs there is offered unto God a true, proper, and 'propitiatory Sacrifice for the Quick and the Dead; 'and that in the moſt holy Sacrament of the Euchariſt 'there is truly, really, and ſubſtantially, the Body and 'Blood, together with the Soul and Divinity of our 'Lord *Jeſus Chriſt*; and that there is a Converſion 'made of the whole Subſtance of the Bread into the 'Body, and of the whole Subſtance of Wine into the 'Blood; which Converſion the Catholick Church calls 'Tranſubſtantiation *.'

Art. 18. 'I confeſs under one Kind only, whole 'and entire, *Chriſt* and a true Sacrament *is* † taken and 'received.'

Art. 19. 'I do firmly believe that there is a Pur-'gatory, and that the Souls kept Priſoners there do 'receive Help by the Suffrages (or Prayers) of the 'Faithful.'

☞ Art. 20. 'I do likewiſe believe that the Saints 'reigning together with *Chriſt* are to be worſhipped and 'prayed unto; that they do offer Prayers unto God for 'us; and that their Relicks are to be had in Veneration.'

Art. 21. 'I do moſt firmly aſſert, that the Images of '*Chriſt*, of the Bleſſed Virgin, the Mother of God, 'and of the other Saints, ought to be had and retained, 'and that due Honour and Veneration ought to be 'given them.'

Art. 22. 'I do affirm that the Power of Indulgen-'cies was left by *Chriſt* in the Church, and that the 'Uſe of them is very beneficial to Chriſtian People.'

* This Article is not only blaſphemous, but even ridiculous beyond Meaſure, ſince every one knows that Matter, (*viz.* any Subſtance) cannot be in two or more Places at one and the ſame Time: Therefore let us charitably conclude, that the more learned Sort of Perſons cannot poſſibly believe this Article, though they are bound to give their Aſſent to it.

† It is well worthy our Notice to obſerve, the Verb *is*, in this Article, is not good Grammar: For Chriſt and the Sacrament being two diſtinct Things, the *Verb* ſhould be *are*. But to reconcile this with the foregoing Article, they have put the Verb *is* to ſhew, that the real Body and Blood of Chriſt, and the Euchariſt, are one and the ſame. This is a cunning, but wicked Inconſiſtency, and downright Sophiſtry.

Art.

Art. 23. 'I do acknowledge the Holy Catholic 'Roman Church to be the Mother and Miſtreſs of all 'Churches; and I do promiſe and ſwear true Obedi- 'ence to the Biſhop of *Rome*, the Succeſſor of St. 'Peter, the Prince of the Apoſtles, and Vicar of *Jeſus* 'Chriſt.'

Art. 24. 'I do undoubtedly receive and profeſs all 'other Things which have been delivered, defined, 'and declared by the ſacred Canons and occumenical 'Councils, and eſpecially by the holy Synod of *Trent*; 'and all other Things contrary thereunto, and all He- 'reſies condemned, rejected, and anathematized by the 'Church, I do likewiſe condemn, reject, and anathe- 'matize.'

Conſider, *Tyro*, whether theſe Impoſitions are conſiſtent with Chriſtian Liberty.

IX. *Of* TURKEY *in* Europe.

Tyr. How is *Turkey* ſituate?

Phil. Turkey is bounded on the N. Part by *Poland*, on the E. by the *Black Sea*, and Part of *Turkey* in *Aſia*, on the S. by Part of the *Ionian Sea*, and on the W. by the *Gulf of Venice*, and Part of *Germany*. It lies between thirty-ſix and forty-nine Degrees N. Latitude. Its Metropolis is *Conſtantinople*, whoſe Diſtance from *London* is twenty-three Degrees three Fourths, *viz.* about one thouſand ſix hundred and fifty Miles E. by S.

The Length of this Country is about ſix hundred and ſixty Miles, and its Breadth about the ſame. The longeſt Day in the moſt northern Part is about ſixteen Hours, and the ſhorteſt in the moſt ſouthern about nine Hours three Quarters.

The Diviſion of TURKEY.

Tyr. Is not *Turkey* divided into different Parts or Claſſes?

Phil. Yes, into many, but chiefly into four, *viz.* 1. *Hungary.* 2. *Greece.* 3. *Little Tartary*, called by ſome *Crim Tartary*, from a large Town. 4. The *Danubian* Provinces.

1. HUNGARY.

Hungary, though now chiefly under the Emperor of *Germany*, is notwithſtanding a Part of *Turkey*. It is

bounded on the N. by Part of *Poland*, on the E. by *Tranſilvania*, on the S. by *Sclavonia*, and on the W. by *Auſtria*. Its chief City is *Buda*, whoſe Diſtance from *London* is better than twelve Degrees and a Half, *viz.* about eight hundred and forty Miles S. E.

2. GREECE.

Tyr. How is *Greece* ſituate?

Phil. Greece is bounded on the N. by the *Danubian* Provinces, on the E. by the *Ægean Sea*, called *Archipelago*, on the S. and W. by the *Mediterranean*. Its chief Cities are *Athens* (or *Settines*) and *Andrianople*; the firſt of which is about four hundred and twenty Miles S. W. of *Conſtantinople*, and the other about one hundred and forty-ſix N. W. of the ſame. *Corinth* is about fifty-four Miles W. of *Athens*, and *Thebes*, or *Stives*, is about forty-five N. W. of *Athens*.

3. LITTLE TARTARY.

Tyr. How is *Little Tartary* ſituate?

Phil. Little Tartary is bounded on the N. by Part of *Moſcovia*, on the E. by *Georgia*, on the S. by the *Black Sea*, and on the W. by *Podola*.

Its Metropolis is *Kaffa*, ſubject to the *Turks*; it ſtands near the *Euxine Sea*, about three hundred and eighty Miles N. E. of *Conſtantinople*, and about five hundred Miles S. of *Moſcow*.

4. *Of the* DANUBIAN *Provinces.*

Tyr. What do you mean by the *Danubian* Provinces; and how are they ſituate?

Phil. They are ſo called, becauſe they chiefly ſtand upon, or near the *Danube*, which extends itſelf from *Kilia*, near the *Black Sea*, to *Vienna* in *Germany*.

Tyr. How many Provinces are there?

Phil. Nine; 1. *Tranſilvania*. 2. *Valachia*. 3. *Moldavia*. 4. *Romania*. 5. *Bulgaria*. 6. *Servia*. 7. *Boſnea*. 8. *Sclavonia*. 9. *Croatia*.

SECT. III.

Of the EUROPEAN *Iſlands; and,*

I. *Of* ENGLAND.

Tyr. How is *England* ſituate?

Phil. England (called alſo *Anglia*, *Britannia*, or *Albion*)

bion) is bounded on the N. by *Scotland*, on the E. by the *German Ocean*, on the S. by its own Channel, which parts it from *France*, and on the W. by St. *George*'s, or the *Iriſh Sea*. It lies between fifty and fifty-ſix Degrees N. Latitude. Its Length is about three hundred and twenty, and Breadth about two hundred and ninety Miles. Its Metropolis is *London*, whoſe Latitude is about fifty-two Degrees and thirty Minutes.

This Iſland contains thirty-eight Counties (beſides *Middleſex* and *Cheſhire)*: It has two Univerſities, *Cambridge* and *Oxford*, and twenty-four Biſhopricks.

Tyr. Are theſe all the Counties in *England?*

Phil. Yes, excluſive of *Wales*, which has four Circuits, twelve Counties, and four Biſhopricks. The longeſt Day in the moſt northern Part is about ſeventeen Hours and a half, and the ſhorteſt in the moſt ſouthern about eight Hours.

II. *Of* SCOTLAND.

Tyr. How is *Scotland* ſituate?

Phil. Scotland (call'd alſo *Caledonia)* is bounded on the N. and W. by the *Baltick Sea*, on the E. by Part of the *German Ocean*, and on the S. by *England*. It lies between fifty-five and fifty-nine Degrees N. Latitude. Its Length is about two hundred and forty, and Breadth about one hundred and eighty Miles, and its Metropolis is *Edinburgh*, whoſe Diſtance from *London* is nearly four Degrees and a half, *viz.* about three hundred Miles almoſt N. The longeſt Day in the moſt northern Part of this Country is about eighteen Hours and a half, and the ſhorteſt in the moſt ſouthern ſix Hours and a half.

III. *Of* IRELAND.

Tyr. How is *Ireland* ſituate?

Phil. Ireland (call'd by ſome *Britannia Parva*, and by others *Hibernia*) is ſurrounded by the *Britiſh Ocean*. It lies between fifty-one and fifty-five Degrees of N. Latitude. The Length is about two hundred and ſixty, and Breadth about one hundred and fifty Miles. Its Metropolis is *Dublin*, which is diſtant from *London* nearly three Degrees and a half, *viz.* about two hundred and forty Miles N. W. The Length of the longeſt

Day in the moſt northern Part is about ſeventeen Hours and a half, and the Length of the ſhorteſt in the moſt ſouthern about ſeven Hours three Quarters.

SECT. IV.

I. *Of the leſſer* European *Iſlands, and firſt of ſuch as lie near* Great Britain.

1. *Thoſe on the* North *are,*

1. The *Orkneys*, or *Arcades*. 2. *Shetland.*

2. *Thoſe on the* Eaſt *are,*

1. *Holy Land.* 2. *Fern Iſland.* 3. *Cocket Iſland.* 4. *Sheepy Iſland.* And 5. The *Iſle of Thanet.*

3. *Thoſe on the* South *are,*

1. *Portland Iſland.* 2. The *Iſle of Wight.* 3. *Portſea Iſland.* 4. *Iſlands of Jerſey and Guernſey.*

4. *Thoſe on the* Weſt *are,*

1. *Lewis Iſland.* 2. *Skye.* 3. *Mul.* 4. *Jura.* 5. *Ila.* 6. *Arran.* 7. *Man.* 8. *Angleſey.* And, 9. *Scilly.*

II. *Of other* European *Iſlands more diſtant from* Great-Britain.

1. *The* AZORES.

Theſe Iſlands lie W. of *England*, and are ſubject to the King of *Portugal.* They are nine in Number, *viz.* 1. St. *Michael.* 2. St. *Maria.* 3. *Tercera.* 4. *Gratioſa.* 5. St. *George*'s. 6. *Pico.* 7. *Fyal.* 8. *Flores.* And, 9. *Cuervo.*

2. *Thoſe of* SWEDEN.

Theſe are eight in Number, *viz.* 1. *Rugen.* 2. *Bornholm.* 3. *Ocland.* 4. *Gothland.* 5. *Oeſal.* 6. *Dago.* 7. *Aland.* 8. *Ween.*

3. *Thoſe of* DENMARK.

Theſe are nine, *viz.* 1. *Zealand.* 2. *Funen.* 3. *Langland.* 4. *Laland.* 5. *Falſter.* 6. *Mona.* 7. *Femeren.* 8. *Alſen.* And, 9. *Iceland.*

4. *Thoſe of* NORWAY.

Theſe are four, *viz.* 1. *Carmen.* 2. *Hiſteren.* 3. *Sanien.* 4. *Suroy.*

5. MEDI-

5. MEDITERRANEAN *Iſlands.*

Tyr. How many Iſlands go under this Name, and how are they ſituate?

Phil. There are twenty-one nominal Iſlands, which are ſituate S. of *Europe*, on or near the *Mediterranean Sea*; but the following are the moſt noted, viz 1. *Yvica*. 2. *Minorca*. 3. *Majorca*, ſituate W. of *Valencia* in *Spain*. 4 *Corſica*. 5. *Sardinia*, lying S. of *Genoa*. 6 *Malta*. 7. *Sicily*, lying S W. of *Naples*. 8. *Cyprus*. 9 *Candia*. And, 10. *Rhodes*, S. of *Antolia* and *Archipelago*.

The other ſmall Iſlands are of little or no Signification. Thus much for *Europe*.

DIALOGUE III. SECT. I.

Of ASIA.

Tyr. IN what Part of the Globe is *Aſia* ſituate?

Phil. *Aſia*, though called the ſecond, yet is the principal Quarter of the Globe, lying upon the E. Part thereof, and extends itſelf from ten Degrees S. Latitude, to ſeventy-ſix N. Latitude, and is divided into five principal Parts, viz. 1. *Tartary*. 2. *China*. 3. *India*. 4. *Perſia*. And, 5. *Turkey*.

1. *Of* TARTARY.

Tyr. How is *Tartary* ſituate?

Phil. *Tartary* is bounded on the N. by the *Tartarian Ocean*, or *Frozen Sea*, on the E. by the ſame, and the *Main Ocean*, on the S. by *China*, *India*, and *Perſia*, on the W. by *Moſcovia* or *Ruſſia*. It lies between thirty-five and ſeventy-ſix Degrees N. Latitude, and under the ſeven, eight, nine, ten, eleven, twelve, and thirteen N. Climates; is about three thouſand Miles long, and two thouſand two hundred and fifty broad, and its chief City is *Cambalie*. The longeſt Day in the moſt northern Part is about two Months, and the ſhorteſt in the moſt ſouthern about nine Hours three Quarters. It is ſubject to the *Great Cham*'s deſpotic Government.

2. *Of* CHINA.

Tyr. How is *China* ſituate?

Phil. *China* is bounded on the N. by Part of *Tartary*, on the E. by the *Chineſian Ocean*, on the S. by Part of

the *Indian Ocean*, on the W. it has *India* without the *Ganges*. It lies between the fourth, fifth, and ſixth N. Climates, is about one thouſand four hundred Miles long, and one thouſand two hundred and ſixty broad, and its chief City is *Pekin*, whoſe Diſtance from *London* is ſeventy Degrees and a half, viz. about four thouſand nine hundred Miles E. and from *Pekin* to *Nankin* about ſix hundred and ninety Miles S. E. in the former of which is a Bell eleven Feet Diameter, and twelve Feet high, weighing about fifty-three Tons and a Half. The longeſt Day in the moſt northern Part is about fourteen Hours three Quarters, and the Length of the ſhorteſt in the moſt ſouthern is about ten Hours three Quarters. It is under the Government of the *Great Cham*.

3. *Of* INDIA.

Tyr. How is *India* ſituate?

Phil. India is bounded on the N. by Part of *Tartary*, on the E. by *China*, on the S. by the Gulph and Bay of *Bengal*, and on the W. by *Perſia*. It lies between nine Degrees of S. and thirty-four of N. Latitude. Its Length is computed one thouſand ſix hundred and eighty Miles, and Breadth much the ſame, and lies under the third, fourth, &c. N. Climates. It is divided into three grand Parts, viz. 1. The Great *Mogul*'s Empire, containing *Delli Agra* (his Imperial Seat), *Cambaia* and *Bengal*. 2. *India* within the *Ganges*, whoſe chief Kingdoms are *Decan*, *Golcond*, *Biſnagar*, and *Malabar*. 3. *India* without the *Ganges*, whoſe chief Kingdoms are *Pegu*, *Tonquin*, *Chochinchina*, and *Siam*; this laſt contains *Martiban*, *Siam*, and *Molucca*, ſubject to the King of *Pegu*. Length of Days and Nights much the ſame as in *China*.

4. *Of* PERSIA.

Tyr. How is *Perſia* ſituate?

Phil. Perſia is bounded on the N. by the *Caſpian Sea*, on the E. by *India*, on the S. by the *Perſian Gulph* and *Indian Ocean*, and on the W. by *Aſiatic Turkey*. It lies between twenty-five and forty-five Degrees of N. Latitude, and under the third and fourth N. Climates. Its Length is computed about one thouſand four hundred and fifty Miles, and Breadth one thouſand two hundred and fifty. It is divided into three Parts, N. Middle and

S.

S. It is governed by the deſpotic power of the *Great Sophy*. They are chiefly *Mahometans*. The longeſt Day in the moſt northern Parts is about fourteen Hours three Quarters, and the ſhorteſt in the moſt ſouthern about thirteen Hours one Quarter.

5. *Of* TURKEY *in* ASIA.

Tyr. How is *Turkey* ſituate?

Phil. Turkey, ſituate in *Aſia Minor*, is bounded on the N. by the *Black Sea*, on the E. by *Perſia*, on the S. by Part of *Africa* and Part of the *Indian Ocean*, on the W. by the *Red Sea*. It lies between twelve and forty-ſix Degrees of N. Latitude; is computed about two thouſand one hundred Miles long, and one thouſand ſeven hundred and fifty broad. It contains ſix great Parts; *viz.* 1. *Natolia*, whoſe chief City, or Town, is *Burſa*. 2. *Arabia*, whoſe Metropolis is *Midina*. 3. *Syria*, whoſe Capital is *Aleppo*. 4. *Diarbeck*, whoſe chief City is *Bagdat*. 5. *Turcomania*, whoſe Capital is *Arzerum*. And 6. *Georgia*, whoſe Metropolis is *Teflis*. This vaſt Country is inhabited by *Chriſtians*, *Mahometans*, *Jews*, &c. but is chiefly under the *Ottoman Yoke*.

SECT. II.

Of the Aſiatic *Iſlands*.

Tyro. How many Iſlands are here, and how are they ſituated?

Phil. There are a great Number, but the chief are theſe ſix, whoſe Situation is as follows; 1. *Japan Iſlands*, E. of *China*. 2. The *Philippine Iſlands*, S. W. of *Japan*. 3. The *Moluccas*, S. of *Philippine*. 4. The *Sund*, W. of the *Moluccas*. And 5. *Ceylon*, W. of the *Sund*, whoſe Capital is *Candea*, or *Candy*. And thus much for *Aſia*.

DIALOGUE IV. SECT. I.

Of AFRICA.

Tyro. HOW is *Africa* ſituate?

Phil. Africa, the third Quarter of the World, and ſituate W. on the Globe, is almoſt ſurrounded with the *Atlantic*, *Ethiopian*, and *Indian Oceans*, and is extended from thirty-five Degrees of S. Latitude

to about thirty-five N. It is principally divided into eight Parts; viz. *Egypt*, *Barbary*, *Bildulgerid*, *Zaara*, called the *Deſart*, *Negro Land*, *Guinea*, *Nubia*, and *Ethiopia*, beſides Iſlands.

1. *Of* EGYPT.

Tyro. How is *Egypt* ſituate and divided?

Phil. Egypt is bounded on the N. by Part of the *Mediterranean Sea*, on the E. by the *Iſthmus* of *Fuez* and the *Red Sea*, on the S. by *Nubia*, on the W. by *Barbary* and the *Deſart*. It was formerly called *Miſraim*. It is divided into *North Erefe*, or *Lower Egypt*, whoſe Metropolis is *Sabider*; *Upper Egypt*, whoſe Capital is *Sabid*; and the *Red Sea* and its Coaſts, whoſe Capital is *Coſſir*. It lies between twenty-one and thirty-one N. Latitude, and under the fourth and fifth N. Climates, is about ſix hundred and fifty Miles long, and three hundred broad. It is governed by the *Turkiſh* Emperor, by a *Baſſa* who reſides at *Grand Cairo*.

2. *Of* BARBARY.

Tyro. How is *Barbary* ſituate?

Phil. Barbary is bounded on the N. by Part of the *Mediterranean*, on the E. by *Egypt*, on the S. by *Bildulgerid*, and on the W. by Part of the *Atlantic Ocean*; is extended from twenty-nine to thirty-ſeven Degrees of N. Latitude, and lies under the fourth and fifth N. Climates. Its Length is two thouſand three hundred Miles, and Breadth three hundred and eighty.

Barbary is divided into ſeven different Parts, or Kingdoms, viz. *Morocco*, *Fez*, *Telenſin*, *Algiers*, *Tunis*, *Tripoli*, and *Barca*, whoſe chief Towns are of the ſame Name.

It is chiefly under the Government of the *Grand Turk*, and Emperor of *Morocco*, who is called alſo Emperor of *Africa*, King of *Morocco*, *Fez*, *Sus*, and *Taſſale*; Lord of *Gago*, *Dara*, and *Guinea*, and *Great Zeriff* of *Mahomet*; and conſequently their Religion is *Mahometaniſm*. The longeſt Day is fourteen Hours one Quarter, and the ſhorteſt ten Hours and a half, as in *Egypt*.

3. *Of* BILDULGERID.

Tyr. How is *Bildulgerid* ſituate?

Phil. Bildulgerid is ſituate on the N. by *Parbary*, on the E. by *Egypt*, on the S. by *Zaara*, on the W. by Part

Part of the *Atlantic Ocean*. It lies between twenty-nine and thirty-one Degrees of N. Latitude, and under the third and fourth N. Climates. Its Length is about two thouſand and fifty Miles, and Breadth three hundred. The Length of Days is from fourteen Hours to ten and a Quarter. It is governed by many little Kings, but all ſubject to the *Grand Turk*, or Emperor of *Morocco*.

4. *Of* ZAARA, *or the* DESART.

Tyr. How is this *Deſart* ſituate?

Phil. Zaara is bounded on the N. by *Bildulgerid*, on the E. by *Egypt* and *Nubia*, on the S. by *Negro Land*, and on the W. by the *Atlantic Ocean*.

It is divided into ſeven Parts, viz. *Borno*, *Gago*, *Bardoa*, *Lempta*, *Targa*, *Zuenziga*, and *Zanhaga*, whoſe Capital is *Targaſſa*; the others have the ſame Names as their *Provinces*. It lies under fifteen and twenty-ſix Degrees of N. Latitude, and under the third and fourth Climates, is in Length about two thouſand three hundred and forty Miles, and Breadth about three hundred and thirty. The Days are from ten Hours and a Quarter to thirteen and three Quarters long. Their Government is by ſeveral Lords and Kings, called *Xeques*, and they are chiefly *Mahometans*.

5. *Of* NEGRO LAND.

Tyr. How is the Land of *Negroes* ſituate?

Phil. Negro Land is bounded on the N. by *Zaara*, on the E. by *Nubia*, on the S. by *Guinea*, and on the W. by Part of the *Atlantic Ocean*. It lies between eight and twenty-two Degrees of N. Latitude, and under the ſecond and third N. Climates. It is computed to be about two thouſand two hundred and eighty Miles long, and ſix hundred broad. It is divided into thirteen Provinces, viz. *Genohoa*, *Gelata*, *Tombut*, *Agades*, *Cano*, *Caſſena*, *Guangara*, *Melli*, *Mandinga*, *Gago*, *Guber*, *Zegzeg*, and *Zanfara*, whoſe Capitals are of the ſame Name. The Days are very little different in Length from thoſe in *Zaara*. It is governed by ſeveral Kings, but all, or moſt, are ſubject to the King of *Tombut*. Groſs Idolatry and *Mahometaniſm* prevail here.

6. *Of* GUINEA.

Tyr. How is this Country ſituate?

Phil. Guinea is bounded on the N. by *Negro Land*, on the E. by *Ethiopia Exterior*, on the S. by the *Ethiopian Ocean*, and on the W. by the *Atlantic Ocean*. It is divided into four Parts; 1. The Coaſt of *Maleguette*, whoſe Capital is *Timan*. 2. The *Ivory Coaſt* weſtward, whoſe Metropolis is *Toba*. 3. The *Golden Coaſt* eaſtward, whoſe Capital is St. *George de Mina*. And 4. The Kingdoms of *Benin*, Metropolis *Arda*. *Guinea* lies between five and thirteen Degrees of N. Latitude. Its Length is one thouſand three hundred and twenty Miles, and Breadth about four hundred. It is ſubject to the Emperor of *Guinea*. *Paganiſm* is here practiſed to the Height of ridiculous Superſtition. Their Days are from eleven Hours three Quarters to twelve and three Quarters.

7. *Of* NUBIA.

Tyro. How is *Nubia* ſituate?

Phil. Nubia is bounded on the N. by *Egypt*, on the E. by *Ethiopia Exterior*, on the S. by *Ethiopia Interior*, on the W. by Part of *Zaara* and *Negro Land*. It lies between fourteen and twenty-two Degrees of N. Latitude, and under the ſecond and third Climates. Its Length is about eight hundred and forty Miles, and Breadth about five hundred and ſeventy. It is divided by the River *Nubia* into N. and S. The Capital of North *Nubia* is *Samna*, and of South *Nubia*, a Town or City of the ſame Name.

It is governed by its own independent powerful Prince, who is reported to be very humane. Their Traffic is chiefly at *Grand Cairo*. The Length of the Days are much the ſame as in *Zaara*.

8. *Of* ETHIOPIA INTERIOR.

Tyro. How is this Country ſituate?

Phil. Ethiopia Interior, called alſo the Land of the *Abyſſinians*, is bounded on the N. by *Nubia*, and on the E. S. and Part of the W. by *Ethiopia Exterior*. It lies under the firſt, ſecond, and third N. and S. Climates; and the Length is computed three thouſand ſix hundred Miles, and Breadth about two thouſand and two hundred. *Ethiopia Interior* is divided into eight Provinces, viz. 1. *Barnagaſſo*. 2. *Tigremahon*. 3. *Dobaſſat*. 4. *Fatigar*.

Fatigar. 5. *Angote.* 6. *Amara.* 7. *Beleguanze.* And 8. *Begramedri.* This is governed by its own independent *Prince*, *Lord*, or *Ruler*, called *Naggaſi*, whoſe Government is deſpotical. He ſtiles himſelf the beloved of God, (ſays he ſprung from the Stock of *Judah*) the Son of the Column of *Sion*, the Son of the Seed of *Jacob*, the Son of the Hand of *Mary*, the Son of *Nahu* after the Fleſh, and of St. *Peter* and *Paul* after the Spirit, &c. The longeſt Day in the moſt northern Parts of this Country is about thirteen Hours and a Half, and the ſhorteſt in the moſt ſouthern ten Hours and a Half.

ETHIOPIA EXTERIOR.

Ethiopia Exterior is bounded on the N. by *Abyſſinia*, on the E. W. and S. by the *Ethiopic Ocean.* And, if to this you take in the Land of *Hottentots*, it extends to near thirty-five Degrees S. Latitude. It comprehends the Kingdoms of *Biafara*, *Loango*, *Congo*, and *Angola*; the Empires of *Monoemungi* and *Monomotapa*; and the Coaſts of *Cafres*, *Zanguebar*, *Ajan*, and *Abex.* It is governed by various Princes, and the People are chiefly groſs *Idolaters* and *Mahometans.* As for the *Hottentots*, they ſhew no Sign of any Devotion, only very ſuperſtitious. The Days much as in *Ethiopia Interior.*

SECT. II.

Of the AFRICAN *Iſlands.*

Tyr. What are the principal Iſlands in *Africa?*

Phil. There are many ſmall Iſlands; but the moſt noted are comprehended under four Names, viz. 1. The Iſland of *Madagaſcar.* 2. *Cape Verde Iſlands.* 3. The *Canary.* And 4. the *Madeira Iſlands.*

1. MADAGASCAR.

This is a large Iſland, lying S. E. of *Ethiopia*, and extends from eleven to about twenty-five of S. Latitude; is about one thouſand Miles long, and four hundred broad. It is called by the *Portugueze* St. *Laurence*, becauſe they firſt diſcovered it on that Day. The Inhabitants (except in the eaſtern Part) are chiefly *Pagans* and *Mahometans*; and are ſo governed by their Prieſts (called *Ombiaſſes*) that they are under uncommon Superſtitions.

ſtitions. Thus, if a Child be born upon ſuch a Day, they ſay it is unlucky, and therefore give it to the wild Beaſts; and, if a Woman dies in Childbed, they bury the living Child with her, becauſe it is better ſo (they ſay) than to live without a Mother to take care of it. And thus, by theſe Prieſt-cunning and deluſive Perſuaſions, this Iſland is very thin of Inhabitants. It is under no particular Governor.

2. *Cape* VERDE *Iſlands.*

Theſe lie S. W. of *Barbary*, and N. W. of *Guinea*, between thirteen and ſeventeen Degrees N. Latitude, and are as follows; 1. St. *Anthony*. 2. St. *Vincent*. 3. St. *Lucia*. 4. St. *Nicholas*. 5. *Inſula de Sal*. 6. *Bonaviſta*. 7. *Mago*. 8. St. *Jago*. 9. *Inſula del Fuego*. 10. *Bravo*. The chief Town is *St. Jago*, ſubject to *Portugal*.

3. *The* CANARY *Iſlands.*

Theſe lie N. of *Cape Verde* Iſlands, and under twenty-ſeven and twenty-nine N. Latitude. They are ſeven in Number; viz. 1. *Lancerota*. 2. *Forte Ventura*. 3. *Canaria* (Metropolis the ſame). 4. *Teneriffe*, famous for its Peak, and the firſt Meridian in the *French* Maps. 5. *Gomera*. 6. *Ferro*. And 7. *Palma*. They are ſubject to the King of *Spain*.

4. MADERA, *or* MADEIRAS.

This lies in about thirty-two Degrees N. Latitude, and W. of *Morocco*. Its chief Town is *Tonzal*. It is ſubject to the *Portugueze*.

Tyr. Are theſe all the Iſlands?

Phil. There are ſome of leſs Note, viz. 1. *Zocotora*, ſubject to the *Arabians*. 2. *Comora*, N. W. of *Madagaſcar*. 3. St. *Thomas*. 4. *Prince's Iſland*. And 5. *Annobon*, ſubject to the *Portugueze*, lying W. of *Ethiopia*. 6. St. *Helena*, ſubject to the *Engliſh*, lying S. W. of St. *Thomas's*. And 7. *The Iſle of Aſcenſion*, N. E. of St. *Helena*. And thus much for *Africa*.

Tyr. I return you Thanks, Sir.

Phil. Now, *Tyro*, for the laſt Quarter of the World, viz. *America*.

DIA-

DIALOGUE V. Sect. I.

Of AMERICA.

Tyro. WHAT is *America* called, and how is it ſituate?

Phil. America is called the fourth, or laſt Quarter of the World, and weſtward on the Globe.

It is divided into two principal Parts, one called *North*, and the other *South America*.

I. *Of* NORTH AMERICA.

Tyr. Why is this called *North America?*

Phil. Becauſe it lies on the N. ſide, or Northward of the Equator.

Tyr. Into how many principal Parts is this divided?

Phil. Into five, as follows, viz. 1. *Mexico*, or *New Spain*. 2. *New Mexico*, called *Granada*. 3. *Florida*. 4. *Terra Canadenſis*. And 5. *Terra Arctica*.

1. *Of* Mexico, *or* New Spain.

Tyr. How is this Country ſituate?

Phil. Mexico, diſcovered in 1518, and conquered by the *Spaniards* in 1521, is bounded on the N. by *Novo Granada*, on the E. by the Gulph of *Mexico*, on the W. by *Mare del Zur*, or *Pacific Ocean*, and on the S. by *Terra Firma*. It is very hot, lying chiefly in the torrid Zone, between eight and thirty Degrees of N. Latitude, and is extended to about thirty-eight Degrees of Longitude. The greateſt Length is computed to be two thouſand five hundred and thirty Miles, and Breadth about four hundred and eighty.

Tyr. Into how many principal Parts is this Country divided?

Phil. Into three, called *Audiences*; viz. 1. *Guadalajara*, whoſe Metropolis is the ſame. 2. *Mexico*, Metropolis the ſame. And 3. *Guatalama*, Metropolis *St. Jago de Guat.*

1. *Guadalajara* contains the Provinces of *Cinaola*, *New Biſcay*, *Zazaticas*, *Guadalajara*, *Chiamelton*, and *Zaliſco*.

2. *Mexico*.

2. *Mexico* contains the Provinces of *Panuco*, *Mexico*, *Mechoachan*, *Los*, *Angelos*, *Anlequera*, *Tabaſco*, and *Jucatan*.

3. *Guatalama* comprehends *Soco*, *Nuſco*, *Guatalama*, *Nicaragua*, *Coſta*, *Rica*, *Veragua*, *Honduras*, *Vara*, *Pax*, and *Chiapa*. The longeſt Day in the moſt northern Part of this Country is about thirteen Hours and a Half, and in the moſt ſouthern about twelve Hours and a Half. It is governed by the King of *Spain*, under a Vice Roy, who reſides at *Mexico*. There are *Pagans*, *Idolators*, &c. in ſome Parts; but the Natives adhere, as in *Spain*, to the moſt ſtrict Order of *Papacy*.

2. *Of* NEW MEXICO, *called* NOVA GRANADA.

Tyr. How is this Part of *North America* ſituate?

Phil. This Country was diſcovered by the *Spaniards*, 1540, and is bounded on the N. by *Terra Arctica*, on the E. by *Florida*, on the S. by *Mexico*, or *New Spain*, and on the W. by *California*. Its Bounds are not yet known. The chief Town is *Santa Feé*, the Reſidence of the *Spaniſh* Governor.

3. *Of* FLORIDA.

Tyr. How is this Country ſituate?

Phil. *Florida*, diſcovered alſo by the *Spaniards*, 1497, and poſſeſſed by them, 1527, is bounded on the N. by Part of *Terra Arctica*, on the E. by *Carolina*, or Part of *Terra Canadenſis*, on the S. by Part of *Mexcico* and the *Gulph*, and on the W. by *Mexico*, and *California*. It lies between twenty-five and thirty Degrees of N. Latitude, and under the fifth and ſixth N. Climates, is extended to twenty-three Degrees in Longitude, and computed to be about one thouſand Miles long, and ſix hundred broad, in its greateſt Length and Breadth.

The Natives are groſs Idolators, and the main Part is governed by ſeveral diſtinct Lords, or Rulers: but the Places upon, or near the Sea Coaſts, are ſubject to the *Engliſh*. The longeſt Day in the moſt northern Part is about fourteen Hours one Quarter, and the ſhorteſt in the moſt ſouthern about nine Hours. Its Metropolis is *Coca*.

4. *Of*

4. *Of* TERRA CANADENSIS.

Tyr. How is this ſituate, and why ſo called?

Phil. It takes its Name from the River *Canada*. It is bounded on the N. by Part of *Terra Arctica*, on the E. by the *Atlantic Ocean*, on the S. by Part of the Sea and the Iſland of *Cuba*, and on the W. by *Florida*, *Canada*, &c. It lies between thirty and ſixty-two Degrees of N. Latitude, and extends to near forty Degrees of Longitude; it is about one thouſand eight hundred Miles in Length, and one thouſand two hundred and ten in Breadth.

Tyr. But pray, is it not divided into ſome principal Parts?

Phil. Yes, into N. and S. The N. comprehends, 1. *Terra Canadenſis Propria*. 2. *Nova Britannica*, or *New Britain*. 3. *Nova Francia*, or *New France*. Chief Town *Quebeck*.

Tyr. What does the S. Part contain?

Phil. 1. *Nova-Scotia*. 2. *New England*. 3. *New York*. 4. *New Jerſey*, *E. and W.* 5. *Penſylvania*. 6. *Maryland*. 7. *Virginia*. And 8. *Carolina*, all in the Poſſeſſion of, and ſubject to, the Crown of *Great Britain*.

The Metropolis of theſe Towns in Order are, 1. *Halifax* in *Nova-Scotia*. 2. *Boſton*. 3. *New York*. 4. *Elizabeth*. 5. *Philadelphia*. 6. *Annapolis Royal*. 7. *James Town*. And 8. *Charles Town*.

N. B. *Theſe lie one after another in order from N. to S.*

1 *Nova-Scotia*, diſcovered 1622. 2 *New England*, in 1497, and poſſeſſed for Queen *Elizabeth*, by Sir *Philip Armadas*, 1558. 3. *New York*, by Mr. *Hudſon*, 1608, and ſold to the *Dutch*, who kept it till 1664; at laſt was given by *Charles* II. to the Duke of *York*; it was called before *New Netherland*. 4. *New Jerſey* was diſcovered in 1497. 5. *Penſylvania*, about the ſame Time, was given by *Charles* II. to *William Penn*, Eſq; by Letters Patent in 1680. 6. *Virginia*, firſt diſcovered in 1427, but more particularly in 1584, by Sir *Walter Raleigh* (who is ſaid to be the firſt that brought Tobacco over

to

to *England*) in the Reign of Queen *Elizabeth*; and was thus called in Honour to her as a Virgin Queen. 7. *Maryland* was alſo diſcovered by the *Engliſh* under the two *Cabots*, 1497, is bounded on the N. by *Penſylvania*, and on S. by *Virginia*. It has its Name from *Mary*, Wife of *Charles* I. who gave it by Letters Patent under that Name, to the Right Hon. *Cæcilius Calvart*, Lord *Baltimore*, 1632. 8. *Carolina*, diſcovered about the Time with *Virginia*, and in 1660 granted by Patent, to ſeveral Noblemen, by *Charles* II.

5. *Of* TERRA ARCTICA.

Tyr. What do you mean by this Name?

Phil. It is called *Arctica*, becauſe it comprehends thoſe Countries of *America* ſituate far North, very near the North or *Arctic* Pole, or Polar Circle.

Tyr. Which be they?

Phil. There are many of them; but the chief, and moſt noted are, 1. *Greenland*. 2. *Spitſberg* 3. *Nova Zembla*. 4 *Terra de Jeſſo*. 5. *New Denmark*. And 6. *New North Wales*

Theſe are known very little at preſent, but barely their Names, therefore cannot be taken any further Notice of.

II. *Of* SOUTH AMERICA.

Tyr Why is this ſo called?

Phil. Becauſe it lies chiefly on the S. Side of the Equator.

Tyr. Into how many principal Parts is it divided?

Phil Into eight, viz. 1. *Terra Firma*. 2 *Peru*. 3. The *Land of the Amazons* 4 *Braſil* 5. *Chili*. 6. *Paraguay*. 7. *Terra Magellanica*. And 8. *Terra Antarctica*.

1. *Of* TERRA FIRMA.

Tyr How is this ſituate?

Phil *Terra Firma* was diſcovered in 1514, lies under the firſt N. Climate, and is bounded on the N. by Part of *Mexico*, on the E. by Part of the *Atlantic*, on the S. by *Peru* and Part of *Brazil*, and on the W. by *Mar del Zur*. It is extended to about twenty-ſeven Degrees and a Half

a Half Longitude, and lies under from one to eleven Degrees and a Half N. Latitude. It is computed to be about fifteen hundred Miles long, and ſeven hundred and fifty broad.

Tyr How is it divided?

Phil. Into E. and W. The E. upon the River *Orinoque*, called 1. *Guian*, whoſe chief Town is *Manhoa*. And 2. *Caribana*, whoſe Metropolis is *Moreſbego*. The W. comprehends the Provinces of 1. *Panama*, called alſo *Terra Firma*; whoſe chief Town is *Panama*. 2. *Carthagena*, Metropolis the ſame. 3. St. *Martha*, Metropolis the ſame. *Rio de la Hacha*, Metropolis the ſame. 5. *Andaluzia*, Metropolis *Comana*. 6. *Paria*, Metropolis *Maluregvara*. 7. *Granada*, Metropolis St *Feé de Bagato*. 8. *Papayan*, Metropolis St *Feé de Antiochia*.

It is governed by the King of *Spain*, by a Vice-Roy reſiding at *Mexico*. The Natives of this Country, eſpecially in the Middle, are groſs Idolators.

2. *Of* PERU.

Tyr. How is this Country ſituate?

Phil. Peru, firſt diſcovered by the *Spaniards* in 1525, is bounded on the N. by Part of *Terra Firma*, on the E. by *Amazonia*, on the S. by *Chili*, and on the W. by *Mar del Zur*. It lies between twenty-four Degrees of S. and one Degree of N. Latitude, and is extended to twenty Degrees of Longitude, and under the firſt, ſecond, and third S. Climates.

Tyr. How is it divided?

Phil. Into ſix Provinces. 1 *Poſto*, whoſe Metropolis is *Poſton*. 2. *Los Quixos*, whoſe Metropolis is *Baeſa*. 3 *Pacamores*, whoſe Metropolis is *Valladolid*. 4. *Quito*, Metropolis *Quito* 5 *Peru*, Metropolis was *Lima*. 6. *Los Carcas*, Metropolis *Potoſi*.

The Natives in general are very groſs Idolators, worſhipping Sun, Moon, Stars, Thunder, Lightening, *&c.* But in ſome Parts there are Chriſtians, *&c.*

It was quite conquered by the *Spaniards* in 1533, and they have the moſt conſiderable Part of it under their Government.

3. *Of*

3. *Of the Land of the* AMAZONS.

Tyr. How is this Land ſituate?

Phil. This Country, diſcovered by the *Spaniards* in 1541, is bounded on the N. by *Terra Firma*, on the E. by *Brazil*, on the S. by *Paraguay*, and on the W. by *Peru*.

It lies under the firſt, ſecond, and third S. Climates. It is under no particular Government: The Inhabitants in general being a ſavage Sort of People, appearing always in Arms. It is ſuppoſed to take its Name from thoſe warlike Women called (by ſeveral Poets and Hiſtorians) *Amazons*, of whom it is reported they cut off one of their Breaſts, not only for the better qualifying themſelves to hold their Bows, and ſhoot the ſurer, but that they might be the more ſavage and rapacious.

4. *Of* BRASIL.

Tyr. How is *Braſil* ſituate?

Phil. This Country, diſcovered by the *Portugueze*, in about 1501, is bounded on the N. by *Terra Firma*, on the E by the *Atlantic Ocean*, on the S. by *Paraguay* and Part of the *Main Ocean*, and on the W. by the Land of the *Amazons*.

It lies between one and twenty-three Degrees of S. Latitude, and under the firſt, ſecond, third, and fourth S. Climates

Its greateſt Length is computed about one thouſand ſix hundred Miles, and its Breadth about one thouſand three hundred and eighty.

Tyr. Into how many principal Parts is it divided?

Phil. There is not any particular Account of its Provinces, Diviſions, *&c.* but the chief Towns that are known, or moſt worthy of Note, are as follow: 1. *St. Vincent.* 2. *Sanctos.* 3. *Angra Dos Reyes.* 4. *St. Sebaſtian.* 5. *Spiritu Sancto.* 6. *Porto Seguro.* 7. *St. Salvadore.* 8. *Pernambuco.* And 9. *Parayba.*

They are under no particular Government nor Religion, being chiefly ſunk into all Ignorance, Idolatry, *&c.*

5. *Of*

5. *Of* CHILI.

Tyr. How is this Country ſituate?

Phil. Chili, diſcovered by the *Spaniards* about 1554, is bounded on the N. by *Peru*, on the E. by *Paraguay*, on the S. by *Terra Magellanica*, and on the W. by the *Pacific Ocean*.

It lies between twenty-five and forty-four Degrees of S. Latitude, and under the fourth, fifth and ſixth S Climates.

Its Length is computed to be about eleven hundred Miles.

Tyr. Into how many Parts is *Chili* principally divided?

Phil. Into three, *viz.* 1, *Chili Propria*. 2. *Chili Imperial*. And 3. *Chucuito*, whoſe chief Towns are St. *Jago*, *Balvida*, and *Mandoſa*

It is chiefly governed by the Vice-Roy of *Peru*, under the King of *Spain*.

6. *Of* PARAGUAY.

Tyr. How is *Paraguay* ſituate?

Phil. This Country, diſcovered alſo by the *Spaniards* 1546, is bounded on the N. by the Land of the *Amazons* and Part of the Ocean, on the E. by the *Atlantic Ocean*, on the S. by the *Southern Ocean* and *Terra Magellanica*.

Tyr. Whence has it its Name?

Phil. From the River *Paraguay*; but it is called by the *Spaniards* (and currently by others) *Rio de la Plata*.

It lies between eighteen and thirty-ſeven Degrees of S. Latitude, and under the ſecond, third, fourth, and fifth S. Climates, and extends to about thirty-two Degrees of Longitude.

Its Length is computed about twelve hundred Miles, and Breadth about eleven hundred.

Tyr. Into how many principal Parts is it divided?

Phil. The moſt material Provinces are five in Number, *viz.* 1. *Guayra*, whoſe chief Town is *Cividad Real*. 2. *Paragaia Propria*, whoſe chief Town is *Villa Rica*. 3. *Chaco*, whoſe chief Town is *Conception*. 4. *Tucoman*, whoſe chief Town is St. *Jago*. And 5.

Rio

Rio de la Plata, whose chief Town is *Assumption*. It is governed chiefly by a Vice-Roy.

7. *Of* TERRA MAGELLANICA.

Tyr. How is this Country situate?

Phil. It is bounded on the N. by Part of *Paraguay* and *Chili*, on the E. by the *Atlantic*, on the S. by *Terra Antarctica*, and on the W. and S. by the *Great South Sea*. It was discovered about 1519, by one *Ferdinand Magellan*, from whom it took its Name.

8. *Of* TERRA ANTARCTICA.

Tyr. How is this Country situate, and why so called?

Phil. Terra Antarctica signifies those Countries that lie between the *Antarctic* Circle and the S. Pole; the chief of which known are *New Zealand*, *New Guinea*, *New Holland*, and *Terra Australis Incognita*.

SECT. II.

Of the AMERICAN *Islands.*

Tyr. What are the principal Islands in *America*?

Phil. They are ten, which are thus divided.

1. To the N. are, —
   1. *California.*
   2. *Newfoundland.*
2. *Middle*, the *Antilles*,
   - *Greater*
     3. *Cuba.*
     4. *Jamaica.*
     5. *Hispaniola.*
     6. *Porto Rico.*
   - *Lesser*
     7. *Caribbees.*
     8. *Lucayes.*
     9. *Sotovento.*
     10. *Bermudas.*
3. To the S. 11. The Island of *Terra del Fuego.*

1. *Of* CALIFORNIA.

This Island was once thought to be a Peninsula; the N. Part was discovered by Sir *Francis Drake*, in 1577. It has *Mexico* on the E. and the *Pacific Ocean* on the W. It lies thirty-five Degrees N. Latitude.

2. *Of*

2. *Of* NEWFOUNDLAND.

This Iſland was diſcovered by the two *Cabots*, in the Time of *Henry* VII. 1497; but more perfectly by *Thorn* and *Elcot*, of *Briſtol*, in 1527. It lies between forty-ſeven and fifty-one Degrees of N. Latitude, near *New Britain*.

Avalon is its chief Province, which was built upon by Sir *George Calvart* in 1623, by a Patent granted, and afterwards enjoyed by *Cæcilius*, Lord *Baltimore*. It is ſubject to the Crown of *England*.

3. *Of* CUBA.

This Iſland was diſcovered by the *Spaniards* in 1594. It lies N. of *Jamaica*, N. W. of *Hiſpaniola*, and S. of the *Bahama* Iſlands, between nineteen and twenty-three Degrees N. Latitude, and extends to about eight Degrees of Longitude. It is ſubject to the King of *Spain*; and the chief Towns are the *Havanna* and St. *Jago*.

4. *Of* JAMAICA.

This was diſcovered by one *Columbus*, and poſſeſſed by *Penn* and *Venables* in *Oliver*'s Time. It was firſt called St. *Jago*, but afterwards *Jamaica*, in Honour of *James* Duke of *York*. It lies S. of *Cuba*, and W. of *Hiſpaniola*, and between eighteen and nineteen and one Quarter Latitude, and extends to about three Degrees of Longitude. It is ſubject to the *Engliſh*. Its chief Town is *Port Royal*.

5. *Of* HISPANIOLA.

This was diſcovered alſo by *Columbus* in 1492. It lies between ſeventeen and twenty Degrees of N. Latitude. It has *Cuba* on the N. W. *Jamaica* on the W. and *Porto Rico* on the E. It is chiefly ſubject to the Crown of *Spain*; and its principal Town is St. *Domingo*.

6. *Of* PORTO RICO.

Porto Rico (once called *Johannes Inſula*, and by the Natives *Bonquin*) lies E. of *Jamaica*, about eighteen N. Latitude. It takes its Name from the City and Haven of the ſame Name.

7. *Of*

7. *Of the* CARIBBEE *Iſlands.*

Tyr. Why are theſe Iſlands ſo called?

Phil. From the Inhabitants, who, upon firſt Diſcovery, were found to be *Cannibals*, and the Word is taken for the ſame. They repreſent the Segment of a Circle, are about thirty in Number, and extend from about 17 Degrees N. almoſt to *Terra Firma.*

The chief among them are, 1. *Anguila.* 2. St. *Martin.* 3. *Sancta Crux.* 4. *Barbada.* 5. St. *Chriſtopher's.* 6. *Nevis*, or *Mevis.* 7. *Antego.* 8. *Montſerat.* 9. *Guadalupa.* 10. *Marigalant.* 11. *Dominica.* 12. *Martinico.* 13. *Barbadoes.* 14. St. *Lucia.* 15. St. *Vincent.* 16. *Granada.* And 17. *Tobago.**

8. *Of the* LUCAYES.

Tyr. Why are they ſo called?

Phil. From *Lucayone*, the longeſt of them all. They extend from *Tegeſta* in *Florida*, to the N. of *Hiſpaniola.*

The chief of which are, 1. *Bahama.* 2. *Lucayone.* 3. *Cignatio.* 4. *Guanahani.* 5. *Tuma.* 6. *Tama.* 7. *Samana.* And 8. *Maiaguana.*

The principal of theſe is *Bahama*, near *Cape Florida*, and remarkable for Spiders, they being about two Inches long in general, having ſix Eyes very viſible.

9. *Of the* SOTOVENTO.

Theſe are ſo called by the *Spaniards*, to whom they chiefly belong, and are found from E. to W. along the Coaſt of *Terra Firma.* The principal of them are, 1. *Tinidada.* 2. *Margarita.* 3. *Tortuga.* 4. *Orchilla.* 5. *Rocca.* 6. *Bonayre.* 7. *Curacao.* And 8. *Oruba.*

10. *Of* BERMUDAS.

Bermudas, ſo called from *John Bermudas*, a *Spaniard*, who firſt diſcovered it. It lies between thirty-two and thirty-three Degrees of N. Latitude, E. of *Carolina*, viz. about two hundred and forty *Engliſh* Leagues, and is ſubject to the Crown of *Great Britain.*

* *Note*, Some of theſe belong to the *Engliſh*, ſome to the *French*, and others to the *Dutch.* The chief of theſe is *Barbadoes*, about thirteen Degrees and a half N. Latitude. It is ſubject to the *Engliſh.*

11. *Of*

11. *Of* TERRA DEL FUEGO.

This (according to ſeveral Hiſtorians) is ſo called, on Account of ſeveral Volcanos. It is ſituate S. of *Magellanica*, and parted from the main Continent by the *Streights of Magellan*, lying between fifty-two and fifty-three Degrees S. Latitude.

And thus, *Tyro*, I have given you a ſhort and conciſe Account of every Thing, as far as I could in this Compaſs, and is ſufficient to ſatisfy the Curioſity of any Reader, and to qualify him for the better underſtanding of ſuch Authors as have wrote more largely upon this Subject.

DIALOGUE VI. SECT. I.

Between Philo, *a Tutor, and* Tyro, *his Pupil, concerning the Nature and Deſcription of the* GLOBES.

Tyro. WHAT is a Globe, or Sphere?

A Globe, or Sphere, is a ſolid round Body, contained under one Surface; having a Point in the Middle, called the Center, from whence all Lines drawn to the Surface are equal, and the two Poles are what it involves or turns round upon, (like the Gudgeon of a Water-Wheel) and are repreſented by thoſe two Pieces of Iron or Wire, upon which the Globe turns: That which has got the Index or Dial-Plate upon it is called the North Pole, and the other is the South Pole.

Tyr. What are the Names of the Globes?

Phil. One is called the *Terreſtrial*, or Earthly; the other the *Celeſtial*, or Heavenly Globe.

Tyr. What do they teach us?

Phil. Firſt, the *Terreſtrial Globe* teaches the Knowledge of the Earth and Sea; with the Situation of Places, their Difference of Latitude and Longitude, the Time of the Sun's riſing and ſetting; Length of Days and Nights throughout the Year, and the true Diſtance from one Place to another, *&c.*

Secondly, the *Celeſtial Globe* not only teaches us the Sun's riſing and ſetting, but alſo the riſing and ſetting

ting of any of the fixed Stars; their Declenſions and right Aſcenſion, Diſtance from each other, Time of ſouthing, &c.

SECT. II.

Tyr. What are thoſe Lines called that are marked on the Globes?

Phil. They are called the *great* and *leſſer* Circles.

Tyr. What do you mean by a *great* Circle?

Phil. Great Circles are ſuch as cut the Globe into two equal Parts, paſſing through the Center; all ſuch as do not cut the Sphere in two equal Parts, are called *leſſer* Circles.

Tyr. Pray how many ar the *great* Circles?

Phil. 1. The *Equator*, or *Equinoctial.* 2. The *Ecliptic.* 3. *Zodiac.* 4. The *Brazen Meridian.* 5. The *Horizon.* And 6. The *Colures.* Of theſe in their Order.

1. The *Equator* on the *Terreſtial*, or *Equinoctial* on the *Celeſtial Globe*, is a Line, or Circle, that cuts the *Globe* in two equal Parts, dividing the N. from the S. and upon the *Globe* is eaſily known by two broad Lines running parallel to each other, and a fine Hair Line between them: It is divided into three hundred and ſixty equal Parts, called Degrees, beginning at the firſt Meridian (or Sign *Aries*) and is marked from one with ten, twenty, thirty, forty, &c. to three hundred and ſixty, quite round; and upon *Senex*'s Globes (now *Martin*'s) you have under the *Equator*, at the Meridian of *London*, a Cypher thus o; and from thence are marked the Degrees of Longitude from *London*, with ten, twenty, thirty, &c. to one hundred and eighty Degrees to the Right-hand, or Eaſt; and backwards from *London*, with ten, twenty, thirty, &c. to one hundred and eighty, weſtward.

2. The *Ecliptic* is another great Circle of the Sphere, which cuts the *Equator* at the two Points, *Aries* and *Libra*, making an Angle at each Point of twenty-three Degrees thirty Minutes, which is its furtheſt, or utmoſt Extent, either N. or S. from the *Equator*.

The

The *Ecliptic* (like the *Equator*) is divided into three hundred and ſixty Degrees, but not numbered from one, ten, twenty, *&c.* as the *Equator* is, but is divided into twelve equal Parts, containing thirty Degrees each, which are called *Signs*, and have different *Names* and *Characters*. Thus,

The NORTHERN SIGNS *are*,

Aries.	*Taurus.*	*Gemini.*	*Cancer.*	*Leo.*	*Virgo.*
♈	♉	♊	♋	♌	♍

The SOUTHERN *are*,

Libra.	*Scorpio.*	*Sagittarius.*	*Capricorn.*	*Aquarius.*	*Piſces.*
♎	♏	♐	♑	♒	♓

You muſt remember alſo, that *Aries* ♈ is called the *Ram*; *Taurus* ♉ the *Bull*; *Gemini* ♊ the *Twins*; *Cancer* ♋ the *Crab*; *Leo* ♌ the *Lion*; *Virgo* ♍ the *Virgin*; *Libra* ♎ the *Scales*; *Scorpio* ♏ the *Scorpion*; *Sagittarius* ♐ the *Archer*; *Capricorn* ♑ the *Goat*; *Aquarius* ♒ the *Water-pot*; and *Piſces* ♓ the *Fiſhes*.

3. The *Zodiack* is a broad imaginary Circle, which extends itſelf (according to the Rules of *Aſtronomy*) eight Degrees on each ſide of the *Ecliptic*, and is that which contains the twelve Signs, and in which the Planets perform their Revolutions.

4. The *Brazen Meridian*, is another great Circle, which divides the *Globe* into two equal Parts. It is repreſented by a thick *Braſs Hoop*, which ſurrounds the *Globe*, from N. to S. and divides the *Equator* into two equal Parts, *viz.* the Eaſt from the Weſt, and is that on which the *Globe* itſelf is hung, or turns round upon by its *Axis*, the Extremities of which are called the Poles; that where the Dial-Plate is fixed is called the North Pole, and the other is the South Pole, oppoſite to it.

Tyr. How is the *Brazen Meridian* marked or divided?

Phil. Like the *Equator* and *Ecliptic*, into three hundred and ſixty Degrees; but with this Difference, it is divided into four nineties, *viz.* from the *Equator* towards the N. and S. Poles the *Meridian* is marked with a Cypher over the *Equator* thus, (o) and on each Side,

with ten, twenty, thirty, forty, fifty, ſixty, ſeventy, eighty, and ninety, which ends in each Pole. Then again, from each Pole to the *Equator* on the other Half of the *Meridian*, is marked ten, twenty, thirty, forty, *&c.* to ninety, which ends in the *Equator*.

5. The *Horizon* is that great Circle which divides the Heavens and Earth into two equal Parts, one called the upper, and the other the lower *Hemiſphere*. There are two Sorts, the one called the *ſenſible* or *natural*, the other the *rational*, or *mathematical Horizon*, viz.

1. The *ſenſible Horizon* is that which divides the viſible Part of the Heavens from the inviſible; and is that great Circle which we ſee all round us (ſtanding upon any Hill, or at Sea) and ſeems as if the Heavens and Earth coincided, or joined together.

2. The *rational Horizon* paſſes through the Center of the Earth, is repreſented by that broad *wooden* Circle, lying with its Face upwards, having two Notches cut in it, one in the N. and the other in the S. Part, in which the *Brazen Meridian* is ſlipt, or moved up and down with Pleaſure. The Poles of the *Horizon* are the *Zenith* and *Nadir*. Obſerve further, there are four Circles on the Face of the wooden *Horizon*, viz.

1. The inner Circle, or that Circle at the inward Edge next the Globe, is divided into twelve equal Parts, or Signs, anſwering to the twelve Signs in the *Ecliptic*, with their Names likewiſe prefixed to them.

2. Next to theſe Signs is a *Calendar* of the Months, according to the *Julian* Account, or *Old Stile*.

3. Next to this is another *Calendar*, according to the *Gregorian* Account (done by Pope *Gregory* XIII in the Year 1582) called the *New Stile**.

* ☞ *Note*, Though this Deſcription of the *Horizon* anſwers moſt Globes, yet you are to obſerve, that on *Senex*'s Globes (and I ſuppoſe others) made ſince the Alteration of the Stile, the *New Stile* is put upon the inner Circle next the Signs on the *Horizon*, and the *Old Stile* is outward. But this can be no Difficulty; for it is very eaſy to be ſeen which is the *New*, and which is the *Old Calendar*, on any Globes; the *New* being eleven Days before the *Old*, ſo that one being known, the other will eaſily be known alſo.

Laſtly.

Laſtly. On the outward Verge of the *Horizon* is the Circle of the *Winds*, or *Rhumbs*, viz. the *Mariner*'s Compaſs, being thirty-two in Number, (beginning at the N.) each *Point*, or *Rhumb*, contains eleven Degrees one Quarter; for thirty-two multiplied by eleven one Quarter, makes three hundred and ſixty.

The Uſe of the *Horizon* ſhews the *riſing* and *ſetting* of the Sun, Length of Days and Nights; alſo the *riſing* and *ſetting* of the Stars in any Latitude; together with the *Azimuth*, *Amplitude*, *Almicanter*, &c. of the Sun, or any Star, and the Point they riſe and ſet upon, *&c.*

6. The *Colures* are two *great* Circles, cutting the *Equator* at right Angles, and paſs through the Poles of the World.

The *Solſticial Colure*, is that *great* Circle which paſſes through *Cancer* and *Capricorn*, ſhewing *Winter* and *Summer*.

The *Equinoctial Colure* paſſes through *Aries* and *Libra*, and ſhews the *Spring* and *Autumn*.

SECT. III.

Of the leſſer *or* parallel *Circles.*

Tyr. What do you mean by the *leſſer* or *parallel* Circles?

Phil. All ſuch Circles as do not divide, or cut the Globe into two equal Parts; but that cut off any Segment, or Part, leſs than the Half, are *leſſer* Circles.

Tyr. Why are they called *parallel* Circles?

Phil. Becauſe they are *parallel* every where to the *Equator**.

Tyr. Which are the principal?

Phil. They are the *Tropics* and *Polar Circles.*

* ☞ In the *Latitude*, or *Parallel* of *London*, a Degree contains about thirty-ſeven Miles on the *Equator*; ſuch are the Tropics of Cancer and Capricorn, the Polar Circles, and all other Circles from the North to the South, that run parallel to the Equator Eaſt or Weſtward; and you are farther to obſerve, that all the Inhabitants under the Equator have their Days and Nights always equal; but if you go further North or South, then the Days are two, three, four or five Days, or two, three, four, or five Weeks, or two, three, four, or five Months long, as you will ſee by and by.

1. *Of the* TROPICS.

Tyr. Pray which are the *Tropic Circles?*

Phil. Look for the Sign *Cancer* on the Globe, and you will find a Circle drawn with a double Line from thence round the *Globe*, parallel to the *Equator*, which is called the *North Tropic*, or *Tropic* of *Cancer*, being twenty-three Degrees and an Half from the *Equator* northward, ſhewing the Sun's greateſt northern Declination. Then looking for the Sign *Capricorn*; you will find the ſame Sort of Circle, which is called the *Southern Tropic*, being alſo twenty-three Degrees and a Half from the *Equator*, and ſhews the Sun's greateſt ſouthern Declination, or Variation from the *Equinoctial.*

2. *Of the* POLAR CIRCLES.

Tyr. Which are the *Polar Circles?*

Phil. They are two ſmall Circles, lying near the Poles (*viz.* twenty-three Degrees and an Half Diſtance) drawn alſo with double Lines: that on the N. is called the *Arctic Circle*, and that on the S. the *Antarctic Circle.* Theſe Circles are the Poles of the *Ecliptic.*

Tyr. Pray what is their Uſe, or what do we learn from them?

Phil. All thoſe Inhabitants that live under theſe Lines have their longeſt Day juſt twenty-four Hours, and their longeſt Night the ſame (ſave the Benefit of Twilight, which is but trifling). If you go further to the Poles, their Days are two, three, and four Days, or two, three, four, or ſix Months long*.

DIALOGUE VII. SECT. I.

Of the Appendants *belonging to the* Globes.

Tyr. WHAT do you mean by *Appendants?*

Phil. Appendants are in ſome Reſpects the ſame as *Appurtenances*, being ſuch neceſſary Things, both moveable and immoveable, as belong to Globes; the principal or chief of which are as follow. 1.

* This and many other Things you will find more fully proved, and better explained, in my Uſe of the Globes.

The

The *Index*, or *Hour Circle*. 2. The *Quadrant* of *Altitude*. 3. The *Semi Circle*. And 4. The *Nautical Box*.

1. The *Hour-Circle*, called alſo the *Horary Circle*, or *Dial Plate*, is a ſmall Circle of Braſs, divided into twenty-four Hours; the upper twelve repreſent Noon, and the lower twelve Midnight. It is ſkrewed on the brazen Meridian round the North Pole, and to the Pole itſelf is placed the *Index* or *Hand*, which turns round with the Globe.

Its Uſe is to tell the Time of the riſing and ſetting of the Sun or Stars, in any Latitude; and what o'Clock it is in any Part of the World, *&c.*

2. The *Quadrant* of *Altitude* is a thin Piece of pliable Braſs, divided into ninety Degrees, anſwering the Degrees of the *Equator*, beginning at the lower End with (o) to ten, twenty, thirty, *&c.* to ninety At which Figure it has a Nut, which ſlips upon the Meridian at Pleaſure, and is faſtened thereto by a Skrew. Its Uſe is to tell the Height of the Sun, or Stars, at any Hour, and when they are due Eaſt and Weſt. Alſo the Diſtance of the Stars from one another, and the Diſtance of one Place from another on the terreſtrial Globe, *&c. &c. &c.*

3. The *Semi-Circle* is of Braſs, divided into one hundred and eighty Degrees, anſwering one Half of the *Equator*. It may be called a double *Quadrant* of *Altitude*, but is uſed only in ſome particular Problems, the *Quadrant*, or *Horizon*, ſupplying its Place.

4. The *Nautical-Box* is an Inſtrument uſed in Navigation, having the thirty-two Points of the Wind marked or drawn on a *Card* or *Sea Chart*, and an Index being touched with a Load-ſtone points always northward. This *Card*, or *Chart*, is hung in an *Horizontal Plane*, and fixed on any Part of the *Horizon* of the Globe, or elſewhere, to ſhew what Point of the Compaſs you are ſailing upon, or are in.

SECT. II.

Concerning the different Names of the Sphere, *according to its different Poſition, or Situation.*

Tyr. What do you mean by the *Sphere*'s having different Names according to its Poſition?

Phil. There are three Sorts of *Spheres*, viz. a *Parallel*, a *Right*, and an *Oblique Sphere*.

1. *A* Parallel Sphere.

A Parallel Sphere *has this Poſition.*

1. The Poles are in the *Zenith* and *Nadir*; that is, one Pole is right up, and the other right underneath. 2. The *Equator* will be in the *Horizon*.

The Property *of this* Sphere.

The Inhabitants of this *Sphere* are thoſe that live under the Poles, and have the longeſt Days and Nights of any other Inhabitants; their ſhorteſt Day being twenty-four Hours long, and their longeſt ſix Months*.

2. *A* Right Sphere.

A Right Sphere *has this Poſition.*

1. The Poles will lie, or be in the *Horizon*. 2. The *Equator* will be in the *Zenith* and *Nadir*. 3. The *Equator* and all the leſſer Circles will cut the *Horizon* at right Angles, *viz.* perpendicularly.

The Property *of this* Sphere.

The Inhabitants of this *Sphere* are thoſe who live under the *Equinoctial Line*, or *Equator*, and have their Days and Nights always equal; *viz.* twelve Hours each.

3. *An* Oblique Sphere.

An *Oblique Sphere* is that Poſition of the Globe, that has the three following Properties, *viz.* 1. One Pole is as much above the *Horizon* as the other is underneath. 2. The *Equator* is Part above, and Part under the *Horizon*. 3. The *Equator* and all the parallel Circles cut the *Horizon* obliquely.

The Property *of this* Sphere.

The Inhabitants of this *Sphere* are thoſe that live in all other Parts, except under the *Poles* and *Equinoctial Line*.

* See my Geography, Pages 95 and 96.

SECT.

SECT. III.

Of the ZONES, *or* CLIMATES.

1. *Of the* ZONES.

Tyr. What do you mean by the *Zones?*

Phil. A *Zone*, or *Girdle*, is a Tract, or Space, that ſurrounds the Surface of the Earth, as a *Belt*, or *Girdle* does the Body.

Tyr. How many *Zones* are there?

Phil. Three; *viz.* 1. *Torrid.* 2. *Temperate.* And 3. *Frigid Zones.*

1. The *Torrid Zone* extends from the *Equator* to the *Tropic* of *Cancer Northward*, and to the *Tropic* of *Capricorn Southward*, twenty-three Degrees and a Half each, (very nearly) *viz.* forty-ſeven Degrees in all.

2. The *Temperate Zones* extend themſelves from the two *Tropics* to the *Polar Circles* on both Sides the *Equator*; *viz.* forty-three Degrees each, being together eighty-ſix Degrees.

3. The *Frigid Zones* extend from the *Polar Circles* to the *Poles*, being each twenty-three Degrees and a Half; *viz.* forty-ſeven in Breadth: So that twenty-three and a Half, forty-three, and twenty-three and a Half, make ninety Degrees; the Diſtance from the *Equator* to either *Pole*. Or rather thus, the *Torrid Zones* contain forty-ſeven Degrees, the *Temperate* eighty-ſix, and the *Frigid* forty-ſeven, in all one hundred and eighty Degrees.

2. *Of the* CLIMATES.

Phil. Climates are Tracts, or Circles, upon the Surface of the Globe, of ſuch a certain Breadth from the *Equator* to either *Pole*, that the Length of the *artificial* Day (*viz.* from the Sun riſe to Sun ſet) is juſt Half an Hour longer than in the next *Climate* nearer the *Equator*, till you come to the *Polar Circles*, and then, indeed, the Day differs in each *Climate* one entire Month.

Tyr. How many *Climates* are there that differ by the Half Hour, and how many by the entire Month?

* *England* and Part of *Scotland* is in the nineteenth *Climate*, *viz.* from about fifty-one and a Half, to fifty-four Degrees and a Half Latitude, that is, near three Degrees Extent.

Phil. There are ſixty *Climates* in all; *viz.* thirty on each Side of the *Equator*, called accordingly *North* and *South*: Of theſe ſixty, forty-eight of them extend from the *Equator* to the *Polar Circles*, and each differ by Half Hours. And the remaining twelve are contained between the *Polar Circles* and the *Poles*, each differing one entire Month from the other.

DIALOGUE VIII. Sect. I.

An Explanation of the moſt uſeful Terms uſed in Geography *and* Aſtronomy.

Tyr. WHAT are the Names of the Terms uſed in *Geography* and *Aſtronomy?*

Phil. They are chiefly as follows.

1. *Zenith*, which is that Point of the Heavens that is right over Head.

2. *Nadir*, is that Point right under Feet, being directly, or diametrically, oppoſite to the *Zenith*.

3. *Zenith Diſtance*, is the Number of Degrees that the Sun, or any Star, wants of ninety Degrees, when they are upon the Meridian or greateſt Height.

4. *Altitude*, is Height. *Meridian Altitude* is the greateſt *Altitude*, or Height, at Twelve o'Clock.

5. *Declination*, is the Diſtance of the Sun, or any Star from the *Equator*, or *Equinoctial*, counted on the *Brazen Meridian* in Degrees, and is called *North* or *South*, according to which Side of the *Equinoctial* the *Declination* is.

6. *Right Aſcenſion*, is an *Arch* of the *Equinoctial*, contained between the Sign *Aries* ♈, and the Degree of the *Equinoctial*, that is cut by the *Brazen Meridian* when the Sun or Star is brought to the *Meridian*.

7. *Oblique Aſcenſion*, is that *Arch* or *Degree* of the *Equinoctial* contained between the Sign ♈, and the Degree of the *Equinoctial*, which is cut by the *Horizon* at the riſing of the Sun or Star.

8. *Oblique Deſcenſion*, is juſt the reverſe, being the Degree of the *Equinoctial* cut by the *Horizon* at the ſetting of the Sun or Star

9. *Aſcenſional Difference*, is the Difference of Degrees between the *right* and *oblique Aſcenſion*, which, converted

ed into Time, by allowing fifteen Degrees for every Hour, ſhews how much the Sun or Star riſes or ſets before or after Six. That is, ſubſtract the *Oblique* from the *right Aſcenſion*, tells the *aſcenſional* Difference.

10. *Amplitude*, is an *Arch* of the *Horizon*, contained between the true E. and W. Point at the riſing and ſetting of the Sun or Stars, counted in Degrees from the E. and W. Points of the *Horizon* where they riſe and ſet, and is called *North* or *South Amplitude*, accordingly.

11. *Azimuth* is, in effect, the ſame as *Amplitude*, ſave only with this Difference; that whereas *Amplitude* is only to riſing and ſetting, *Azimuth* ſhews the Diſtance from the E. and W. Points at any Time, when the Sun or Stars are above the *Horizon**.

12. *Elevation* of the Pole is the ſame as *Latitude*.

Latitude of a Place is its Diſtance from the *Equator*, either *North* or *South*, numbered in Degrees on the *Brazen Meridian*: Or, in other Words, it is the *Elevation* of the Pole above the *Horizon*.

Longitude of a Place is an *Arch* of the *Equator*, intercepted between the firſt *Meridian* (or Point *Aries* ♈) on the *Equator* and the *Meridian* of the Place.

SECT. II.

Containing two neceſſary and uſeful TABLES; *viz.*

TABLE I.

A TABLE *of the* Latitude *and* Longitude *of ſome of the moſt principal* Places, *from the lateſt Obſervation.*

N. B. The Longitude here is taken from the Meridian of *London*, which is near 18 Degrees E. of the firſt Meridian *Ferol* (on *Senex*'s or *Martin*'s Globe); So that by adding or ſubſtracting eighteen Degrees, you have

* *Note*, *Azimuth* is not expreſſed alike in all Authors. Some call it always *North*, or *South Azimuth*, and reckon the *Azimuth* from theſe two Points eaſtward or weſtward. Others reckon it from the Eaſt and Weſt Points, either northward or ſouthward; which, I think, is beſt, they being the two Points that *Azimuth* is neareſt to in our, or any leſſer Latitude, at any Hour: However, it matters not which, if you mind this one Rule; ſuppoſe I ſay, the Sun has ſixty Degrees *Azimuth* from the N. eaſtward, it is the ſame as if I ſay he has thirty Degrees *Azimuth* from the E. northward.

the Longitude from the firſt Meridian, that is, by knowing one you may know both; the *Equator* being marked, or graduated, for both.

Places.	Latitude.		Longitude.	
	° ′		° ′	
Adrianople, *Turkey*, in *Europe*	43 30	N.	27 24	E.
Alexandria, *Egypt*, in *Africa*	31 25		30 50	
Amſterdam, in *Holland* (and Capital)	52 29		5 15	
Babylon, in *Chaldea* (called *Bagdad*)	34 45		48 45	
Barbadoes, in the *Weſt Indies*	13 14		59 50	W.
Bengal, in the *Eaſt Indies*	21 00		88 00	E.
Boſton, in *New England*	43 10		69 30	W.
Cadiz, *Andaluſia*, in *Spain* (and Capital)	30 30		5 45	W.
Cairo, *Egypt*, in *Africa*	36 5		40 00	W.
Candia, in the *Iſland of Candia*	34 55		24 50	E.
Canton, in *China*	23 12		112 52	
Candy, in the *Iſland of Ceylon*	8 15		80 30	
Cape of Good Hope, S. of *Africa*	34 45	S.	18 00	
Cochin China, *Eaſt Indies*	13 00	N.	107 00	
Conſtantinople, *Romania* in *Turkey* (and Capital)	41 40		29 40	
Copenhagen, Capital of *Denmark*	55 40		12 35	
Cracow, Capital of *Poland*	50 15		20 50	
Edinburgh, Capital of *Scotland*	55 56		3 00	
Hague, in *Holland*	52 10		4 4	
Hanover, *Saxony*, in *Germany*	52 16		10 0	
Jeruſalem, *Paleſtine*, in *Aſia*	32 44		36 15	
Koningſburgh, *Pruſſia*, in *Poland*	54 55		22 15	
Lima, in *Peru*, in *South America*	11 30	S.	78 40	W.
Liſbon, Capital of *Portugal*	38 45	N.	8 20	
London, Capital of *England*	51 32		0 0	
Madagaſcar, an Iſland in *Africa*	19 26	S.	43 55	E.
Madrid, *New Caſtile*, in *Spain* (Capital)	40 10	N.	3 28	W.
Malta, near *Sicily*, in *Mediterraneau*	39 10		4 00	
Moſcow, Capital of *Muſcovy*	55 30		39 30	
Nankin, or *Nanquin*, in *China*	31 00		118 30	
Naples, in *Italy*	41 45		14 50	
St. Omer's, in *France*	50 50		2 20	
Panama, *North America*	8 30		82 30	W.
Paris, Capital of *France*	48 45		2 20	E.
Peterſburgh	60 00	N.	31 32	
Pekin, in *China*	39 52		110 52	E.
Stockholm, Capital of *Sweden*	59 30		19 5	
Tangier, *Barbary*, in *Africa*	35 45		6 00	W.
Tripoli, *Barbary*, *Africa*	33 55		13 50	

TABLE II.

A TABLE *of the right* Aſcenſion, Declination, Latitude, *and* Longitude *of ſome of the moſt eminent fixed* Stars, *taken from* Senex's, (*now* Martin's) *celeſtial* Globe, *for the Uſe of the Learner.*

Names and Conſtellations.	R. A. ° ′	Declin. ° ′	Lat. ° ′	Long. ° ′
Aldebaran, in *Taurus*	65 15	16 15 N.	4 45 N.	6 00 ♉
Bellatrix, in *Orion*	77 30	6 15	15 45	17 00 ♊
Canobus, in *Argo-Navis*	95 30	53 0 S.	76 00	10 00 ♋
Caſtor, in *Gemini*	109 80	32 30 N.	9 45 S.	16 00
Caſtor's Bro. *Pollux*, do.	111 45	28 30	7 00 N.	19 30
Cor Hydra, *Hydra's Heart*	138 30	8 15	22 30	24 00 ♌
Cor Scorpio, *Scorpio's Heart*	243 00	26 00	4 45	5 45 ♐
Cor Leo, called *Regulus*	148 00	13 00	0 45	26 00 ♌
Dubbee, in *Urſa Major*	175 00	55 30	47 30	27 30
Fomahant	341 00	31 0	21 00	30 00
Marhal in *Pegaſſus*	342 15	13 30	19 00	20 00 ♓
Mencar, in *Cetus*	41 36	3 15	12 90	10 00 ♉
Procyon, in *Canicula*	111 00	6 00	15 00	22 00 ♋
Pes Centaurus	216 30	59 30	42 30	26 00 ♏
Regel, in *Orion's Foot*	75 15	9 15	31 00	12 30 ♊
1. *Star*, in the *Girdle of Orion*	79 30	1 00	23 00	17 30
2. ——— ditto	80 30	2 00	24 00	18 30
3. ——— ditto	81 15	3 00	25 30	19 30 ♈
Scheat, in *Pegaſſus*	342 15	26 15	31 00	26 00
Sirius, in *Canis Major*	98 00	16 30	39 15	12 00 ♋
Upper Pointer, in *Urſa Major*	161 30	63 30	50 00	12 00
Lower Pointer, ditto	161 20	58 00	46 00	16 00 ♌
Vindemiatrax, in *Virgo*	192 00	12 30	16 00	5 30

DIALOGUE IX.

Containing ſome uſeful and neceſſary Problems *on the* Terreſtrial Globe.

N. B. (°) ſtands for Degrees, (′) for Minutes.

PROB. I.

The Latitude being given to rectify the Globe *for that Place.*

LET it be required to rectify the Globe for the Latitude of *London* 51° 32′ N. and *Madrid* 40° 10′ N. proceed thus,

Turn the Pole on which the Dial Plate is fixed towards the Verge of the *Horizon*, ſlipping or moving the Globe backwards or forwards in the Notches of the *Horizon*, till the *Horizon* cuts the *Brazen Meridian* in 52° 32′ (viz. a little more than 51 and a Half) ſo is the Globe rectified for the Latitude of *London*; that is, the N. Pole will then be elevated 51° 32′ above the *Horizon*; and *London* being brought to the Meridian itſelf, will then be in *Zenith*, or right up, and at equal Diſtance from all Parts of the *Horizon*.

Depreſs the Pole till the *Horizon* cuts the *Brazen Meridian* at 40° 10′, and you have then the Poſition of the Inhabitants at *Madrid*, and turning the Globe till *Madrid* comes to the Meridian, you will find it in the *Zenith*, or Top of the Globe, under 40° 10′.

Note. If it were required to rectify the Globe for South Latitude, then you muſt elevate the S. Pole to the given Latitude inſtead of the N. Pole; but this is better explained by the next Problem.

PROB. II.

The Latitude and Longitude of any Place given, to find the ſame.

Firſt, You are to obſerve whether the Longitude be reckoned from *London*, or from the firſt Meridian; for on ſome Globes the firſt Meridian begins 23°, on others 20°, and on *Senex*'s Globes, 18° W. of *London*; but if once you know where the firſt Meridian is on the

the Globe, it is very eaſy to know the Difference from the Meridian of *London*.

EXAMPLE.

There are two certain Places, one has 18° N. Latitude, and 77° 5 W. Longitude. The other is 33° 45′ S. Latitude, and 18° E. Longitude from *London*; I demand what Places theſe are.

Rule. For the firſt Place, I elevate to the N. Pole 18°, becauſe it is 18° N. Latitude. Then I turn the Globe to the Right Hand, or Eaſtward, (becauſe the Place lies Weſtward) till 77° 5′ upon the Equator, counted from the Meridian of *London* (which on *Senex*'s Globe has a Cypher thus (o) on the Equator) paſſes through, or under the Meridian: Or, in other Words, I turn the Globe till 77° 5′ Weſtward is brought under the Meridian, and here I fix the Globe with a Quill thruſt in betwixt the Globe and the *Horizon*; then I look under the Latitude 18° (which is in the *Zenith*) on the Meridian a-top of the Globe, and under 18° on the Meridian I find *Port Royal*, in *Jamaica*, the Place required.

For the ſecond Place I elevate the S. Pole (though there is no Occaſion to elevate the Pole barely to find a Place, but it is better, becauſe you have then the real Situation of the Inhabitants) to the given Latitude 34° 45′, and then turn the Globe till 18° E. Longitude of *London* come under the Meridian. Then I look under the Latitude 34° 45′ on the Meridian, and juſt under this I find the *Cape of Good Hope*, the Place required.

PROB. III.

The Latitude of any Place given, to tell all thoſe Places that have the ſame Latitude.

DEFINITION.

All thoſe Places that have the ſame Latitude have the Days and Nights of the ſame Length at the ſame Time of the Year.

Rule. Bring the given Place, or Places, to the Meridian, (ſuppoſe *London* 51° 32′, and *Madrid* 40° 10′ N. then turn the Globe, and all thoſe Places that paſs under

der 50° 32′, have the ſame Latitude as *London*; viz. *Prague* in *Germany*, &c. and all that paſs under 40° 10′, have the ſame Latitude as *Madrid*, which you will find to be *Pekin* nearly for one, and many other Places.

PROB. IV.

To tell the Difference of the Latitude of Places.

Here are two Variations, or Rules.

Firſt, If the Latitudes be both N. or both S. then ſubtract the leſs from the greater Latitude, and the Remainder is the Difference, or Anſwer. Thus between *London* and *Madrid* is 12° 32′, the firſt being 50° 32′, and the other 40°. And between *Candy* and *Stockholm* is 52° 30′, for *Stockholm* is about 59° 30′ N. and *Candy* 7° 30′ N.

Secondly, If one Place lie on the N. and the other on the S. Side of the *Equator*; (that is, if one be N. and the other S. Latitude) then add them both together, and their Sum is the Difference of the Latitude required.

Thus *Copenhagen* is 55° 40′ N. and the Iſland of *Madagaſcar* is 19° 30′ S. theſe added together make 75° 10′, the Difference of Latitude required.

PROB. V.

The Longitude of any Place given from any Meridian, to tell thoſe Places having the ſame Longitude.

This is done after the ſame Manner as the other, only here the Anſwer will be on the *Equator*, as the others were on the Meridian.

I would know what Places have the ſame Longitude as *London*, and the ſame Longitude as *Moſcow*.

The *Rule* is, Bring *London* to the Meridian, then all thoſe Places on the Globe (from the N. Pole to the S. Part of the *Horizon*) that lie under the Edge of the Meridian, have the ſame Longitude as *London*. Thus *Fort Naſſau*, and *Fort Mina*, in *Guinea*, have the ſame, or very nearly the ſame Longitude as *London*.

And *Moſcow*, in *Muſcovia*, has very nearly the ſame Longitude as *Aleppo* in *Syria*: Alſo *Scandaroon*, *Antioch*, and *Tripoli* in *Syria* have the ſame Longitude; *viz.* 37° 30′ from *London*.

PROB.

PROB. VI.

To tell the Difference of the Longitude of Places.

DEFINITION.

☞ 1. No Place can exceed, or be above, 180° of Longitude from another Place; for 181° E. Longitude is with more Propriety 179° W. Longitude, for 181° taken from 360°, there remains 179°, which is neater to the given Place than 181°.

Rule. Here are two Variations.

Firſt, If the Places lie both E. or both W. of the firſt Meridian, or where you reckon the Longitude from; *viz.* if they both be E. or both W. Longitude, then ſubtract one from the other, you have the Difference.

Thus I find *Jeruſalem* has 36° 15′ E. Longitude from *London*, and *Pekin* 110° 52′ E. Longitude; therefore I ſubtract 36° 15′ from 110° 52′, and there remains 74° 37′ Difference of Longitude E. or W. that is, *Pekin* is 74° 37′ E. Longitude of *Jeruſalem*; or *Jeruſalem* is 74° 37′ W. Longitude of *Pekin*.

Secondly, If one Place be E. and the other W. Longitude of the firſt Meridian (ſuppoſe *London*, or any other Meridian) then add their Longitudes together, and the Sum is the Difference of the Longitude required.

EXAMPLE.

I would know the Difference of the Longitude between *Jeruſalem* 36° 15′ E. of *London*, and *Port Royal* in *Jamaica* 77° 5′ W.

Here as one is E and the other W. I add 36° 15, and 77° 5′ together, and their Sum makes 113° 20′ Difference of Longitude. That is, *Jeruſalem* is 113° 20′ E. of *Port Royal*, or *Port Royal* is 113° 20′ W. of *Jeruſalem*.

EXAMPLE.

Pekin in *China* is 110° 52′ E. Longitude, and *Port Royal* is 77° 5′ W. I add theſe Sums together, and find it 187° 57′ Difference of Longitude; but becauſe it is more than 180°, I ſubtract 187° 57′ from 360°, and there remains 172° 3′, the Difference required.

Moſt

Moſt of the following Problems are common to both Globes.

PROB. VII.

The Day of the Month given, to find the Sun's Place in the Ecliptic.

Rule. The Day of the Month being given, look on the inner Calendar on the new Globes, and you have the Sign and the Degree of that Sign that the Sun is in for that Day, according to the *New Stile.*

If it be upon old Globes, look on the outward Calendar, you have the Sign and the Degree of the Sign.

N. B. You may further obſerve, that the Calendar uſed through *Europe* is the Calendar for *N. S.* viz. *New Stile*, and is always known from the other, becauſe it has the *Saints Days*, and ſeveral other Things wrote upon it on the *Horizon.*

EXAMPLE.

I would know the Sun's Place in the Ecliptic on *May* the 21ſt, *N. S. March* the 21ſt, *June* the 21ſt, *September* the 22d, and *December* the 21ſt.

I look for theſe Days of the Months in order as they ſtand in the new Calendar; (*viz.* for *N.* S. before deſcribed) and right againſt the Day of the Month in the innermoſt Circle on the *Horizon*, I find the Sun's Place among the Signs as follows:

Thus right againſt *May* the 21ſt, I find 1° of ♊ *Gemini:* And alſo on *March* the 21ſt, I find he enters ♈ *Aries:* On *June* 21ſt he enters ♋ *Cancer:* On *September* the 22d he enters ♎ *Libra:* and on *December* the 21ſt he enters ♑ *Capricorn.*

☞ Note, That in every Problem and Operation hereafter, except *Old Stile* be mentioned, it is to be underſtood for *New Stile*, viz. *N. S.* and Latitude always means N. Latitude, except expreſſed South.

PROB. VIII.

The Sun's Place given, to find the Day of the Month.

This is only the Reverſe of the former Problem; for having the Sun's Place given, ſeek it in the innermoſt Circle among the Signs; then againſt that Degree in the Calendar *N. S.* you have the Day of the Month required.

E. X-

EXAMPLE.

I would know what Time of the Year the Sun is in 1° of ♊, as alſo when he enters ♈, ♎, ♑, ♋? Proceed according to the Rule, and you will find the Days to be *May* the 21ſt, *March* the 21ſt, *June* the 21ſt, *September* the 22d, and *December* the 21ſt, as in the laſt.

PROB. IX.

The Latitude and Day of the Month given, to find the Sun's Place in the Ecliptic, and rectify the Globes for Uſe.

Rule. Find the Sun's Place on the *Horizon* by *Prob.* VII. and having noted what Degree he is in, look upon the Ecliptic on the Globe, and find the ſame Sign and Degree as you did on the *Horizon*, then bring this Degree of the Ecliptic very carefully to the graduated Edge of the *Brazen Meridian*, and holding the Globe ſteady, turn the Index exactly to the upper Twelve, (which repreſents twelve at Noon) and thus is the Globe rectified for that Day, and the Degree of the Ecliptic that lies under the *Equator*, repreſents the Sun's Place at Noon, or Twelve o'Clock that Day.

☞ The *Aſtronomer's* Day is reckon'd from, or begins at Twelve o'Clock; and, if you fix the Quadrant of Altitude to the Latitude in the *Zenith*, the Globe will be compleatly rectified.

PROB. X.

To tell the Declination of the Sun on any Day of the Year.

Rule. Having found the Sun's Place in the Ecliptic for the given Day, bring it to the *Brazen Meridian*, and obſerve what Degree of the Meridian it lies under, and whether it be on the N. or on the S. Side of the *Equator*, for that is the Declination required, which is called N. or S. Declination accordingly. Thus on *April* the 21ſt the Sun has 11° 30′ N. Declination, and on May the 21ſt he has 20° 30′ Declination, but on *October* the 27th he has 12° 30′ South Declination.

PROB.

PROB. XI.

The Latitude and Day of the Month given, to tell the Sun's Meridian Altitude; viz. his Height at Noon.

Rule. Bring the Sun's Place to the Meridian, and obſerve what Degree of the Meridian the Sun's Place is under; for thoſe Degrees on the Meridian that are intercepted, or lie between the S. Verge of the *Horizon*, and the Degree which is over the Sun's Place on the Meridian, (counted on the Meridian) is the Sun's Meridian Altitude required.

Thus I find his Meridian Altitude at *London*, *May* the 21ſt, to be 59°; but on *November* the 5th he has but 23° 30′ Altitude.

PROB. XII.

The Latitude and Day of the Month given, to tell the Sun's Altitude at any Time.

Example. On *May* the 21ſt, at Nine in the Morning, and at Five in the Afternoon at *London*, I would know the Sun's Altitude or Height.

Rule. Rectify the Globe for the Latitude, and bring the Sun's Place (1° ♊) to the Meridian, and the Index to the upper Twelve on the Dial-Plate; then ſkrew the Quadrant of Altitude on the *Zenith* (*viz.* the left Edge of the Nut muſt be fixed on the Meridian at 51° 30′) then turn the Globe till the Index points to the Hour, *viz.* Nine in the Morning; this done, fix the Globe by thruſting in a Quill between it and the *Horizon*; laſtly, turn the Quadrant about till the graduated or figured Edge touch the Sun's Place, (*viz* 1° ♊) and the Degrees on the Quadrant, counted from the *Horizon* upwards on the Quadrant, is his Height at that Time; *viz* 43° 30′ Then turn the Globe till the Index points to Five in the Afternoon; and alſo turn the Quadrant on the W. Side, (without unſkrewing it) till it touches the Sun's Place, and you have about 24° on the Quadrant, his Altitude at that Time.

N. B. At *North Cape* (*viz.* N. Latitude 72°) at Nine in the Morning, *May* 21, he will be but about 32° high.

PROB.

PROB. XIII.

The Latitude given, to tell the Riſing and Setting of the Sun, and Length of the Day and Night at any Time of the Year in any Place.

Rule. Rectify the Globe (*viz.* elevate it for the Latitude, bring the Sun's Place to the Meridian, and Index to the upper Twelve) then turn it till the Sun's Place comes even with, or lies right againſt the inner Verge on the E. Side of the *Horizon*, then the Index will ſhew you the Time of the Sun's riſing; turn it to the W. Side or Verge of the *Horizon*, and the Index will ſhew you the Setting. Or thus, having got the Hour the Sun riſes, count how many it wants of Twelve, for ſo many Hours will it ſet after. Thus, if the Index points to four in the Morning at riſing, it will of Courſe ſet at Eight at Night, *&c.*

Note 1. If you double the Time of riſing, that is, double the Hours it wants of Twelve at the Time of riſing, it gives you the Length of the Day from Sun riſing to ſetting.

Note 2. If you ſubtract the Length of the Day from Sun riſing to Sun ſetting, from Twenty-four, the Remainder ſhews you the Length of the Night, Twilight included. See Prob. 25.

Proceed thus, and you will find the Sun, on *May* 26, at *London*, to riſe about Four in the Morning, and ſets at Eight at Night. Now double what he wants of Twelve at riſing, *viz.* eight Hours, and it gives the Length of that Day at *London*, *viz.* ſixteen Hours.

PROB. XIV.

To tell the Sun's right Aſcenſion.

Bring the Sun's Place to the *Brazen Meridian*, and note what Degree of the *Equator* is cut by the Meridian, for that is his right Aſcenſion required.

I would know the Sun's right Aſcenſion on *March* the 21ſt, *June* the 21, *September* the 22d, and *December* the 21ſt.

I find the Sun's Place for theſe different Days, and bringing it to the Meridian, I find the Meridian cuts the *Equator* in (0) in (90) in (180) and in (270°) his right Aſcenſion required.

Note, When the Sun enters ♈, *March* 21ſt, he has no

no right Aſcenſion, becauſe it is counted from, or begins at ♈; therefore, on March the 20th, he muſt have his greateſt right Aſcenſion, *viz.* 359°.

PROB. XV.

To find the Sun's oblique Aſcenſion and Deſcenſion at any Time, and in any Latitude.

Rule 1. Rectify the Globe for the Latitude, and bring the Sun's Place down to the Eaſtern Verge of the *Horizon*, then obſerve what Degree the *Horizon* cuts the *Equator* in, for that is the oblique Aſcenſion required.

2. Turn the Globe till the Sun's Place comes to, or lies level with the Weſtern Verge of the *Horizon*, and the Degree of the *Equator* cut by the *Horizon*, is the oblique Deſcenſion required.

Thus on *March* the 21ſt, *June* the 21ſt, *September* the 22d, and *December* the 21ſt, *viz.* when the Sun enters ♈, ♋, ♎, and ♑, you will find his oblique Aſcenſion at *London* to be (0) (56) (180) and (304).

And on the ſame Days his oblique Deſcenſion will be (0) (123) (180) and (237 and a Half).

PROB. XVI.

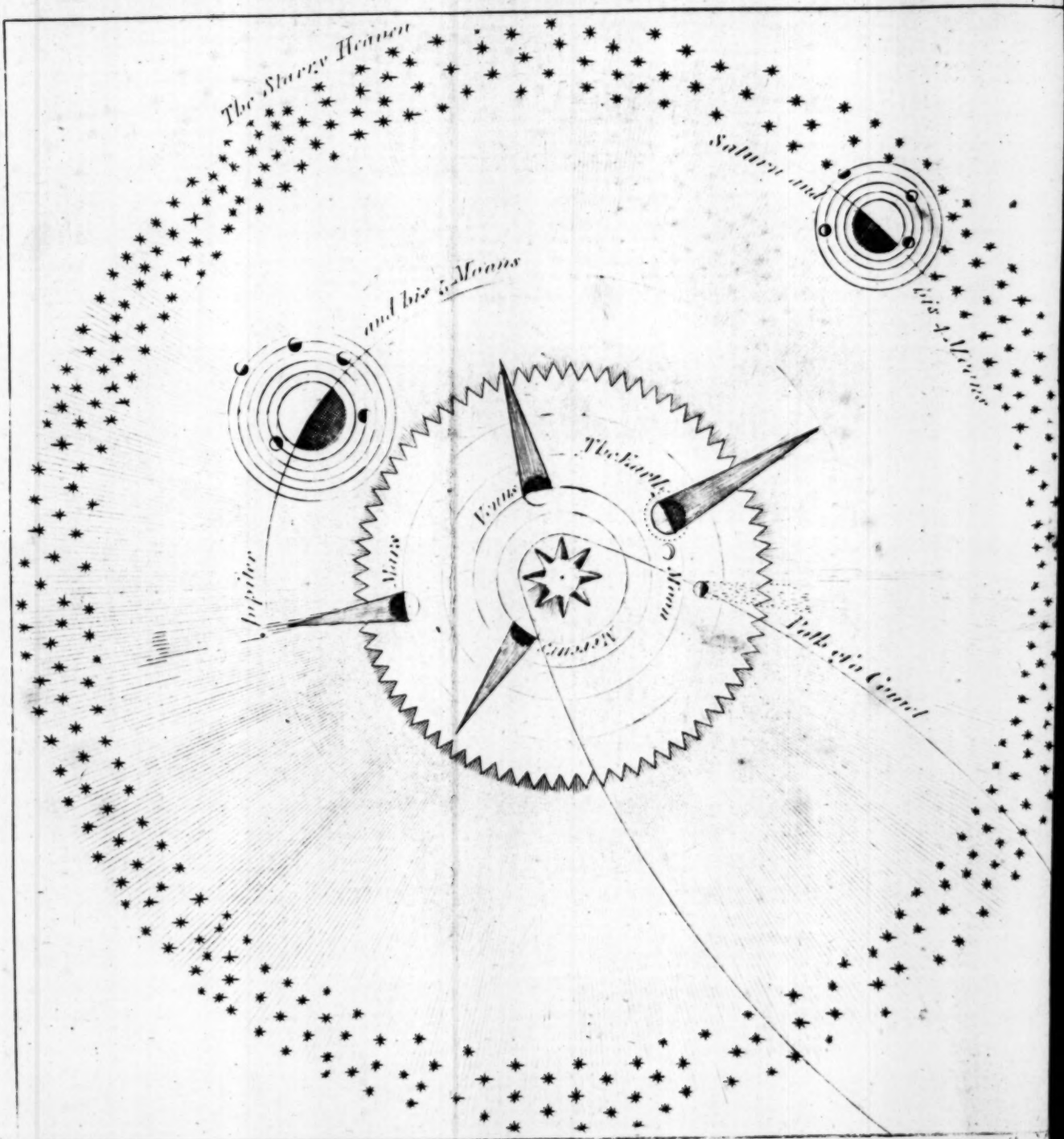
The Latitude and Day of the Month given, to tell the Sun's aſcenſional Difference, viz. how much he riſes, or ſets, before and after Six; and, conſequently to tell the Length of the Days, ſuppoſe there were no Index to the Globe.

Rule. By the laſt Problem find the Sun's right and oblique Aſcenſion; then ſubtract the oblique from the right Aſcenſion, or the contrary, and the Remainder is the aſcenſional Difference required; which divide by fifteen, the Degrees of the *Equator* that paſs through the Meridian for one Hour (or ſeven and a Half for Half an Hour) gives the Anſwer in Time that the Sun riſes and ſets before and after Six.

Thus on *May* the 26th I find the Sun 6° of ♊, and his right Aſcenſion is 64°, and on the ſame Day his oblique Aſcenſion is 34°; now 34° from 64° there remains 30°, his aſcenſional Difference; which divide by fifteen gives two Hours, the Time that he riſes before, or ſets after Six.

N. B.

THE
COPERNICAN or SOLAR SYSTEM.



N. B The right exceeds the oblique Aſcenſion from ♑ to ♋ when the Sun riſes before Six; but the other Half Year that he riſes after, or ſets before Six, the oblique exceeds the right Aſcenſion.

PROB. XVII.

The Latitude and Day of the Month given, to tell the Sun's Amplitude, viz. *his Diſtance from the E. and W. Points at his Riſing and Setting, and the Points of the Compaſs he riſes and ſets upon.*

Rule. The Globe being rectified, bring the Sun's Place to the eaſtern Verge of the *Horizon* (which ſhews his riſing) then the Degrees upon the innermoſt Circle of the *Horizon*, counted from the true E. Point to the Place where the Sun's Place lies againſt on the *Horizon*, ſhews you the Sun's Amplitude.

Proceed according to the Rule, you will find the Sun's Amplitude at *London*, (*May* the 21ſt) at riſing, to be about 34° from the E. to the N. and at ſetting 34° from the W. to the N. and the Point he riſes upon is N. E. by E. and he ſets N. W. by W. But on *November* the 5th he has about 25° and a Half Amplitude from the E. to the S. and at ſetting 25° and a Half from the W. to the S. The Point he riſes upon is E. S. E. and the Point he ſets upon is W. S. W.

PROB. XVIII.

The Latitude and Day given, to tell the Sun's Azimuth, *viz. his Diſtance from the E. and W. or from the N. and S. Points at any Time.*

Rule. Rectify the Globe in general, then turn the Globe till the Index points to the given Hour; this being done, turn the Quadrant till it touches the Sun's Place for the given Day; and then the Quadrant will cut the *Horizon* in the *Azimuth* required from the E. or W. Points, or from the N. or S. Points, for you may reckon from either, only then name it properly and accordingly.

Thus on *Auguſt* the 17th, at Nine in the Morning, the Sun will have about 30° *Azimuth* from the E. to the S. or, which is the ſame, 60° from the S. to the E. for 60° and 30° make 90°, the whole Quarter from E. to S.

N. B.

N. B. Some Authors call this 60° S. Amplitude; but others call it 30° S. Amplitude; that is 30° from the E. to the S. as I ſaid before.

PROB. XIX.

The Latitude, Day, and Hour given, to tell the Sun's Almicanter.

DEFINITION.

Almicanters are Circles of Altitude that run parallel to the *Horizon*, whoſe Poles are the *Zenith* and *Nadir*; ſo that you may imagine as many Circles of Altitude, *viz.* Almicanters, as you pleaſe.

Rule. The Almicanter is found the ſame as the Altitude of the Sun at any Time, therefore I refer you back to *Prob.* XIII.

PROB. XX.

The Latitude and Length of the Day given, to tell what other Day of the Year will be of the ſame Length.

Rule. Having found the Sun's Place for the given Day, bring it to the Meridian, and obſerve well its Declination; then turn the Globe till ſome other Degree of the Ecliptic comes under the ſame Degree of Declination under the Meridian; this being done, ſee what Day of the Month anſwers to the Sun's Place, then under the Meridian, for that is the Day required; which you may eaſily prove.

Thus you will find that *July* the 13th, and *Auguſt* the 20th, is of the ſame Length as *May* the 26th, and *April* the 17th.

PROB. XXI.

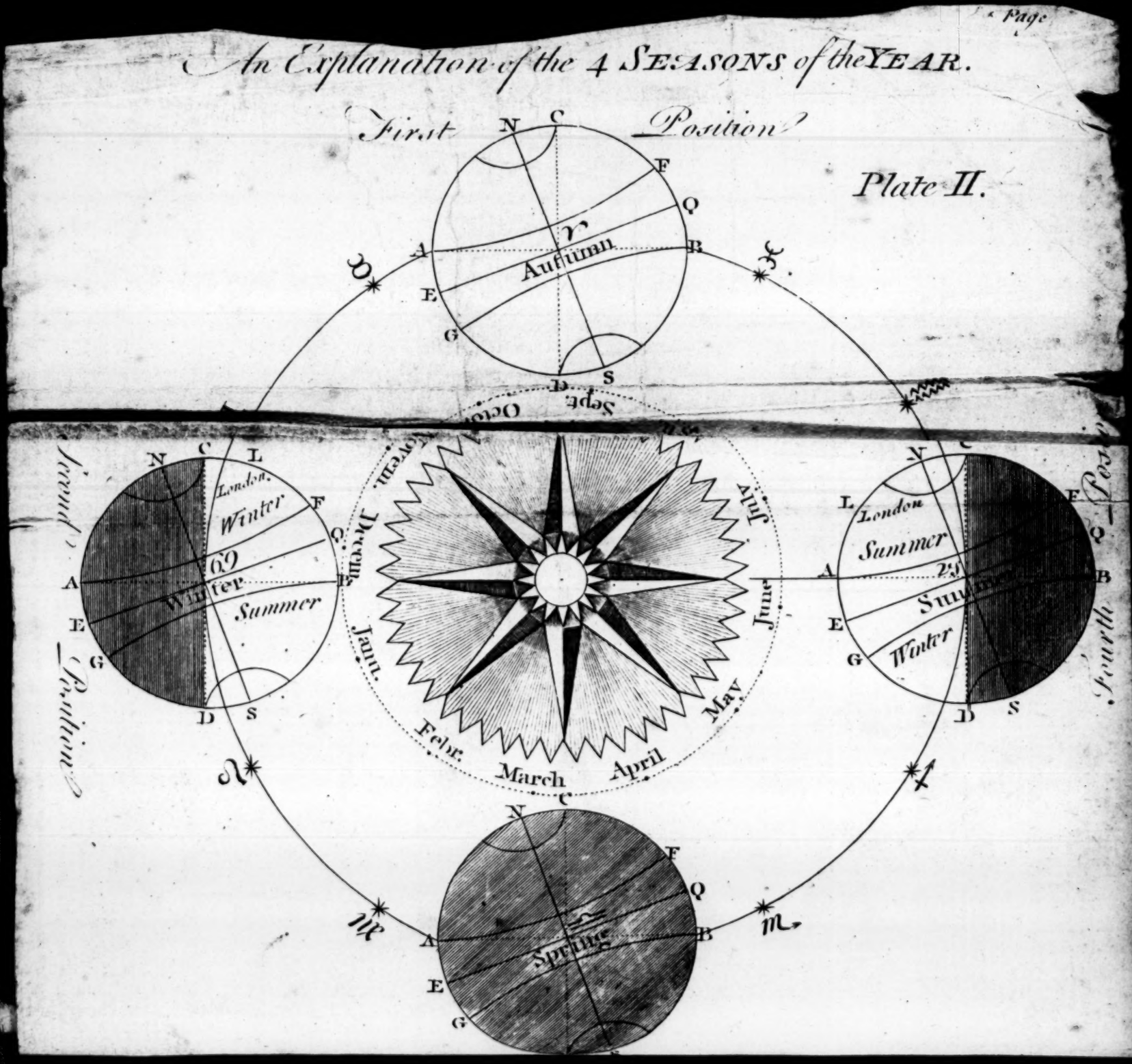
The Latitude and Day given, to tell the Beginning, Ending, and (conſequently) the Length, or Continuance of Twilight.

DEFINITION.

Twilight is that faint Light which begins immediately after the Sun ſets in the Evening, till he is 18° below the *Horizon*; and it begins in the Morning when the Sun comes within 18° of the *Horizon* on the E. Side, and ends when he riſes. Therefore it is plain, that Twilight is not only longer when Days encreaſe in Length,

An Explanation of the 4 SEASONS of the YEAR.

Plate II.



Length, but it is alſo much ſtronger, as you will ſee preſently by the Work of the *Problem*.

Tyro. I have heard that this *Problem* is very difficult to what ſome are?

Philo. It is ſomething longer in its Operation, but very eaſy, if you mind the Rule and Operation together.

OBSERVATION.

Note, You were told that Twilight begins and ends when the Sun is 18° below the *Horizon*, and as the Quadrant of Altitude reaches no lower than the *Horizon*, therefore the Rule is this:

Rectify the Globe and bring the oppoſite Degree of the Sun's Place to the Quadrant of Altitude, ſo that it touches juſt 18° on the Quadrant (then it is plain that the Sun's real Place will be depreſſed 18° below the *Horizon*) then look on the Index, for that will point (if among the Morning Hours) to the beginning, or (if among the Evening Hours) ending of Twilight.

Note 1. What I mean by the oppoſite Place of the Sun is this; it is that Degree of the Ecliptic oppoſite to, or 180° from the given Place of the Sun. Thus, ſuppoſe the Sun was in ♈, then I bring its oppoſite Sign (*viz.* ♎) to 18° on the Quadrant, ſo will ♈ be depreſſed 18°, and the Index will ſhew the Hour.

Note 2. There is no real Night at *London* (but Twilight) from *May* the 22d, to *July* the 20th, the Sun all that Time being leſs than 18° below the *Horizon*.

Proceed then according to the Rule, and you will find that on *March* the 21ſt, and *September* the 22d, Twilight begins about Four in the Morning, and ends about Eight at Night.

The Sun on theſe Days you know riſes and ſets at Six. Add, therefore, the Length of Morning and Evening Twilight to twelve Hours (the Length of the Days then) and it gives ſixteen Hours, this ſubtracted from twenty-four Hours, leaves eight Hours, the Length of the real or dark Night.

So alſo on *April* the 24th, Twilight begins about Half paſt Two, ends about Half paſt Nine, which is in all ſeven Hours. But on *December* the 20th it begins at Six, and ends at Six, which is in all but three Hours and forty Minutes.

PROB.

PROB. XXII.

The Hour given, where you are to tell what Hour it is in any other Part of the World.

Rule. Bring the given Place to the Meridian, and ſet the Index at the given Hour; then turn the Globe till the other Place, or Places, come under the Meridian, and the Index will point to the real Time in the Place required.

Example. When it is Two o'Clock in the Afternoon at *London*, I would know the Time at *Jeruſalem*, and at *Port Royal* in *Jamaica?*

Proceed according to the Rule, and you will find, that when it is Two in the Afternoon at *London*, it is twenty-five Minutes paſt Four at *Jeruſalem*; and but fifty-two Minutes paſt Eight in the Morning at *Port Royal.*

Or thus by *Problem* VI. *Jeruſalem* is 36° 15′ E. Longitude of *London*, I divide, therefore, 36° 15′ by fifteen, and the Quotient is two Hours, and the Remainder is ſix, which is ſix Times four, or twenty-four Minutes, and the odd fifteen Minutes or Miles, is one Minute, ſo that the Difference is two Hours twenty-five Minutes; and as *Jeruſalem* is E. of *London*, it has its Hour before us, therefore it is twenty-five Minutes after Four in the Afternoon. And thus for other Places.

PROB. XXIII.

The Day of the Month given, to tell thoſe Inhabitants that will have the Sun in their Zenith, (or over their Heads) on that Day.

OBSERVATION.

This cannot happen to any other Inhabitants, but in the *Torrid Zones*, that is, to all ſuch as have not above 23° and a Half of Latitude, either North or South.

Rule. Bring the Sun's Place to the Meridian, and obſerve exactly his Declination for that Day; then turn the Globe any Way, and obſerve what Places paſs under that Degree of Declination on the Meridian; for all ſuch will have the Sun right over their Heads ſome Time or other on that Day.

I would

I would know what Inhabitants, or Places, will have the Sun in their *Zenith* on *May* the 21ſt.

Proceed as directed by the Rule, you will find *St. Jago* in *Hiſpaniola*, *St. Jago* in *Cuba*, *Campeachy*, and many other Places, will paſs under that Degree of Declination, *viz.* (20° N.) and will have the Sun in their *Zenith* that Day.

Alſo on *April* the 16th, the Inhabitants of *Porto-Bello*, the *Oroonoko* Iſlands, *Bay of Siam*, *Iſle of Ceylon*, and the *Philippine Iſlands*, will have the Sun that Day in or near their *Zenith*.

PROB. XXIV.

The Day and Hour given in any Place, to tell thoſe Inhabitants, or that Place, to which the Sun is then vertical, viz. *in the* Zenith.

Rule. Bring the given Place to the *Brazen Meridian*, and turn the Index to the given Hour; this done, turn the Globe till the Index points to the upper Twelve, or Noon; then look under the Degree of Declination on the Globe for that Day, for that is the very Spot or Place to which the Sun is then vertical.

Example. On *May* the 13th, at eight Minutes paſt Five in the Afternoon, at *London*, I would know what Place has the Sun in their *Zenith*. Anſwer, *Port Royal* in *Jamaica*.

N. B. There are two Days in which the Sun is vertical to all the Inhabitants in the *Torrid Zones*; which muſt be when the Sun has the ſame Declination, and in this Problem will be *July* the 27th, *viz.* the ſame Declination as on *May* the 13th.

Thus alſo you will find when it is thirty-three Minutes paſt Six in the Morning at *London*, on *April* the 12th, and *Auguſt* the 28th, the Inhabitants of *Candy* in the Iſland of *Ceylon*, will have the Sun then nearly in their *Zenith*.

PROB. XXV.

To tell the Diſtance from one Place to another in Degrees and Minutes (viz. *Miles*) *in an Arch of a great Circle,* as alſo their Bearing, or Situation, in reſpect of each other.*

* *Note*, Sixty Miles, or Minutes, are reckoned a Degree in general; but this is a vulgar Error, for it is proved that every Degree on the Earth's Surface in every great Circle (ſuch as the *Equator*, *Meridian*, &c.) is 69½ Miles; therefore multiply the Degrees by 69½, you have the Diſtance in *Engliſh* Miles.

Rule. Bring one of the Places to the Meridian, and elevate the Globe for the Latitude of it, and fix the Quadrant in the *Zenith:* Then turn the Globe till the Quadrant touches the other Place, and the Degrees on the Quadrant between Place and Place ſhew the Diſtance; and the Quadrant at the ſame Time will cut the *Horizon* in the Point of the Compaſs, called the Bearing, or Situation, from the firſt Place.

Example. I would know the Diſtance from *London* to *Port-Royal*, *Jeruſalem*, and *Moſcow*, as alſo their Situation in reſpect to *London?*

Proceed according to the Rule, and you will find that from *London*

	Degrees.		Miles.
To *Port Royal*	68½	*viz.* nearly	4760¾ W.
To *Jeruſalem*	33¼		2311 E. S. E.
To *Moſcow*	23		1598½ E. N. E.

PROB. XXVI.

The Latitude and Day given, to tell what Time the Sun will be due Eaſt or Weſt.

Rule. Rectify the Globe and Quadrant as before directed; then turn the Quadrant till it touches the E. or W. Point of the *Horizon*; this done, turn the Globe till the Sun's Place for the given Day comes to the Edge of the Quadrant (holding the Quadrant to the E. or W. Point) ſo will the Index point to the Hour of his being due E. or W. on that Day.

Proceed thus, and you will find about five Minutes paſt Seven in the Morning, on *May* the 21ſt, at *London*, the Sun will be due E. and about five Minutes before Five in the Evening due W. On *June* the 21ſt, he will be due E. about twenty-two Minutes paſt Seven in the Morning, &c. but on *December* the 21ſt, he is due E. about thirty-five Minutes paſt Four in the Morning, and due W. about twenty-five Minutes paſt Seven in the Evening.

PROB.

PROB. XXVII.

To find the Antœci *to any Place.*

1. EXPLANATION.

Antœcians are thoſe Inhabitants that have the ſame Longitude, that is, lie under the ſame Meridian, but have the ſame Latitude South as we have North.

2. *Their Property.*

1. Their Hour is the ſame as ours at all Times. 2. Their Days are equal to our Nights, and their Nights to our Days. And 3. Their Summer is our Winter.

3. *To find the* Antœci *to any given Place (ſuppoſe* London).

Bring *London* to the Meridian, and count on the Meridian from the Equator as many Degrees Latitude S. as *London* has N. (*viz.* 51° 32′) and there make a Dot, for that is the Place of the *Antœci*.

PROB. XXVIII.

To find the Periœci *to any Place.*

1. EXPLANATION.

The *Periæcians* are thoſe that lie under the ſame Parallel of Latitude, but have one hundred and eighty Degrees Difference of Longitude.

2. *Their Property.*

1. They have contrary Hours, *viz.* Noon. 2. Their Days and Nights are of the ſame Length with ours. Their Seaſons are alſo the ſame as ours.

3. *Rule to find them.*

Bring *London* to the Meridian, and turn the Globe till one hundred and eighty Degrees of Longitude paſs under the Meridian, then under the ſame Latitude as *London*, *viz.* under 51° 32′ North Latitude) make a Dot, for that is the Place of the *Periæci*, to be in the *Great South Sea*, 51° 32′ S. Latitude, and 180° Longitude.

Thus alſo the *Antipodes*, to *Cape Antonio* in *South America*, is the Bay of *Nankin* in *China*. And the *Antipodes* to *Barbadoes*, is a little Shoal in the Streights of *Sapy*.

PROB. XXIX.

To find the Antipodes.

1. EXPLANATION.

Antipodes are thoſe that live diametrically oppoſite to us; that is, have the ſame Latitude South as we have North, but differ in one hundred and eighty Degrees of Longitude.

2. *Their Property.*

Theſe Inhabitants have 1. Their Hour is contrary to ours. 2. Their longeſt Day is our ſhorteſt. 3. Their Day is our Night. And 4. Their Summer is our Winter, *&c.*

3. *To find them.*

There are three Ways, but the two beſt are theſe.

1. Bring *London* to the North Verge of the Horizon, which is done by ſlipping the Globe up and down till *London* lies cloſe to the Edge of the Brazen Meridian, and cloſe to the Horizon on the North: This being done, look on the South Verge of the Horizon cloſe to the Brazen Meridian, and there make a Dot on the Globe, and you have the *Antipodes*.

2. Bring *London* to the Meridian, and turn the Globe till 180° paſs through the Meridian, and there fix the Globe, then count from the Equator ſouthward on the Meridian 51° 32′, and you will find the ſame Dot to lie cloſe to the Meridian (at 51° 32′) below the S. Part of the Horizon.

PROB. XXX.

The longeſt Day in any Latitude given (ſuppoſing London, *ſixteen Hours and a Half) to tell in what other Latitude the longeſt Day is one, two, three,* &c. *Hours longer than in the given Place.*

Rule. Rectify the Globe for the given Latitude (*viz. London*) and bring the ſolſtitial Colure (*viz.* ♋) to the Meridian; then where the *Horizon* cuts the Tropic of ♋, make a Dot on the Tropic at the Verge of the *Horizon:* This done, turn the Globe weſtward, till 7° and a Half of the *Equator* paſs under the Meridian, and then make a ſecond Dot on the Tropic againſt the

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Horizon as before; then turn the Globe back to its firſt Poſition, (*viz.* to ♋) and then elevate the Pole, till the ſecond Dot appears at the Edge of the *Horizon*, and the *Horizon* at the ſame Time will cut the Meridian in the Latitude required.

Proceed as above, and you will find that in the Latitude 56° 20′, the Days are one Hour longer than at *London*

2. If you want to know the Latitude where the Day is two Hours longer than at *London*, then proceed as before, only inſtead of cauſing 7° and a Half to paſs under the Meridian, you muſt now turn the Globe till 15° paſs under the Meridian, and make then a ſecond Dot on the Tropic, and proceed as before.

Note, If you want to know the Latitude where the longeſt Day is an Hour ſhorter than in *London*, only turn the Globe eaſtward inſtead of weſtward, till ſeven Degrees and a Half paſs through the Meridian, and make a Prick on the Tropic, and depreſs the Pole till this lies even with the *Horizon*, you will find the Latitude about 45° and a Half. Thus for two Hours longer about 60°, for four Hours about 64° 20′; but for two Hours ſhorter the Latitude is about 35° and a Half.

PROB. XXXI.

Any Time not exceeding ſix Months given, to tell that Latitude, or thoſe Places, where the Sun will not ſet for all that Time.

Note, That twenty-eight Days are here reckoned to the Month. Bring the given Time into Days, and take the Half of the Number of Days; but remember to abate 1, if the Half exceeds 30, then count from *Cancer* on the Ecliptic the ſame Number of Degrees as the Half amounted to, and where this Reckoning ends make a Dot on the Ecliptic. *Laſtly*, Bring this Dot to the Meridian, and as many Degrees as are intercepted, or lie between the Dot and the Pole itſelf, counted on the Meridian, is the Latitude required.

Example. I demand the Place, or Latitude, where the Sun does not ſet for the Space of four Months and ſixteen Days?

This is in all one hundred and twenty-eight Days, the Half is 64°, abate 1° is 63°; this I count from ♋ on the Ecliptic, and make a Dot, and bringing it to the Meridian, I find there are nearly 80° between the Dot and the Pole; *viz.* the Latitude is 80°, which is at *Smith's Inlet*, the upper Part of *Greenland*.

So alſo in the Latitude of 85°, he ſets not for five Months two Weeks. And in the Latitude of 86° 30′, for five Months, three Weeks, and three Days; and in the Latitude 90°, not for ſix Months; as you will ſee by the next Problem.

PROB. XXXII.

To tell in the Latitude ninety (the longeſt Day there being ſix Months) how long it continues to be Twilight after Sun ſet; and how long their Night is after Twilight ends, before Twilight begins again.

Note, Remember you were told before, that Twilight begins and ends when the Sun is 18° below the *Horizon*, and that on *September* the 22d the Sun begins to ſet to the Inhabitants at the North Pole, and to riſe to the Inhabitants at the South Pole; ſo that Twilight begins *September* the 22d to the Inhabitants at the North Pole; therefore,

Rule 1. Elevate the Pole to the *Zenith*, and turn the Globe till ſome Degree of the Sun's Place in the Ecliptic lies under 18° of the Brazen Meridian, and under the S. Part of the *Horizon*, and you will find it 24° ♏; *viz.* *November* the 14th, the Ending of Twilight, that is, they have Twilight from *September* the 22d, to *November* the 14th, and then they begin to have dark Nights (ſave the advantage of the Moon) till the 24th of *January*. For

2. Turn the Globe till ſome other Point of the Ecliptic comes under 18°, as before, and you will find it about 5° of ♒, which anſwers to the 24th of *January*, the Beginning of Twilight to the Inhabitants at the N. Pole, and then on *March* the 21ſt, he riſes with them.

Thus it appears, that the Length of their Day (from Sun-riſing to Sun-ſetting) is from *March* the 21ſt, to *September* the 21ſt. The Length, or Continuance, of Twilight, is from *September* the 21ſt, to *November* the 14th, and from *January* the 24th to *March* the 21ſt, in all about one hundred and ten Days, and their real Night is from *November* the 14th, to *January* the 24th, *viz.* about ſeventy-one Days.

Note. The ſame holds good to the Southern Inhabitants at the S. Pole, for he riſes with them when he enters ♎, and ſets with them when he comes to ♈, &c.

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DIALOGUE X. Sect. I.

Containing ſome uſeful Problems on the Celeſtial Globe.

PROB. I.

To find the right Aſcenſion of any Star.

BRING the Center of the Star to the Meridian, and the Degree of the Equinoctial, cut by the *Meridian*, is the right Aſcenſion required.

Thus you will find the right Aſcenſion of *Aldebaran* in *Taurus*, to be about 65°, *Arcturus* in *Bootes*, about 210° 45′, *Regel* in *Orion*, about 75° 30′, and *Sirius*, or the *Dog Star*, about 98°, *&c. &c.*

PROB. II.

The Latitude given, to tell the oblique Aſcenſion and Deſcenſion of any Star.

Rectify the Globe, and bring the Star down to the Eaſtern Verge of the *Horizon*, and the Degree of the Equinoctial that is then cut by the *Horizon*, is the *oblique* Aſcenſion required. Turn the Star to the Weſtern Side, and the Degree of the Equinoctial, cut by the *Horizon*, is the Star's *oblique* Deſcenſion.

Proceed thus, and you will find the *oblique* Aſcenſion of *Regel* to be about 86° 30′, of *Marhal* in *Pegaſus*, about 325°, and of *Aldebaran*, or *Bull's Eye*, about 43° 30′. Turn each of theſe to the Weſtern Side, you will find their *oblique* Deſcenſion 64°, 360° nearly, and 87°.

Note, There is this Difference between the right and oblique Aſcenſion and Deſcenſion of the Sun and Stars. For the Sun's oblique Aſcenſion, *&c.* differs every Day in the ſame Latitude, but the Stars oblique Aſcenſion is every Day the ſame.

PROB. III.

To tell the Declination of the Stars.

As for the Sun's Place, ſo alſo here, bring the given Star to the *Brazen Meridian*, and obſerve what Degree of the *Meridian* lies right over the Center of the Star, for that is the Declination either N. or S. according to which Side of the Equinoctial it lies.

Thus you will find the Declination of *Aldebaran* to be about 16° 45′ N. The upper Pointer to the Pole (in *Urſa Major*) about 63°$\frac{2}{3}$, and the lower one nearly 58°$\frac{1}{2}$ but *Regel* in *Orion* I find about 8°$\frac{3}{4}$ S. and *Cor Scorpio* about 26° South Declination, *&c. &c.*

PROB. IV.

The right Aſcenſion and Declination of any Star given, to find the ſame at once.

Bring the given Degree of *right* Aſcenſion on the Equator to the *Brazen Meridian*, then look under the Degree of Declination on the *Meridian*, and you will find the Star at the *Meridian*, under the given Degree of Declination.

Thus, ſuppoſe I wanted to find *Aldebaran*, whoſe right Aſcenſion is 65° and his Declination 16° 45′ N. I firſt bring 65° of the Equinoctial to the *Meridian*; and looking under 16° 45′ N. Declination on the *Meridian*, I find *Aldebaran*.

So alſo *Sirius* has 98° *right* Aſcenſion, and 16° 30′ S. Declination; therefore I bring 98° of the Equinoctial to the *Meridian*, and looking under 16° 30′ S. Declination on the *Meridian*, I find *Sirius*, juſt at the *Meridian*. The ſame for any other Star.

PROB. V.

To tell the riſing and ſetting of the Stars, and the Point of the Compaſs any Star riſes or ſets upon in any Latitude, and on any Day of the Year.

Rectify the Globe, and bring the Sun's Place to the *Meridian*; then turn the Globe till the given Star comes to the Eaſtern Verge of the *Horizon*, and the Index will point to the Time of riſing, and the *Horizon* will ſhew the Point it riſes upon: Turn it to the Weſt, and the Index will point to the Time of ſetting, and the *Horizon* will ſhew you the Point it ſets upon.

Proceed thus, and you will find that *Aldebaran*, on *November* the 5th, at *London*, riſes a little paſt Six in the Evening, and ſets about Nine in the Morning. The Point he riſes upon, is E. N. E. and the Point he ſets upon, is W. N. W. But *Regel* in *Orion*, the ſame Night,

Night, riſes a little before Nine at Night, and ſets about Half paſt Seven in the Morning. The Points of riſing are W. by S. and ſetting E. by S.

Note, The Stars riſe and ſet every Day on the ſame Point of the Compaſs, though at contrary Hours.

PROB VI.

To tell the Time, viz. *how many Hours any Star continues above the* Horizon, *from its riſing to its ſetting, in any Latitude.*

Rectify the Globe, then bring the Star to the Eaſtern Verge, and note the Time of riſing, then turn the Globe to the Weſtern Side; and the Number of Hours that paſſed through the Dial Plate tells you the Continuance of that Star above the *Horizon*.

Thus, I find *Aldebaran* at *London* continues up from the Time of his riſing on any Day (for Example, take *December* the 25th) about fifteen Hours; and *Regel* about ten Hours and a Half.

At *Stockholm Aldebaran* continues up above ſixteen Hours; but at *Port Royal* he continues up about twelve Hours Three Quarters.

PROB. VII.

To tell the Diſtance of one Star from another in Degrees and Minutes, in the Arch of a great Circle.

To this *Problem* are three Variations;

1. If the Stars lie under the ſame *Meridian*, bring them to the *Brazen Meridian*, and the Degrees intercepted between them, counted on the *Meridian*, is the Diſtance required.

Thus, I find, the two Pointers in the *Great Bear* to be about $5°\frac{1}{2}$ diſtant from each other; and *Eridef* and the *Dolphin's Eye* about $29°\frac{1}{2}$ diſtant.

2. If they lie under the ſame Declination, bring the firſt (at Pleaſure) to the *Brazen Meridian*, and note the Degrees cut by the *Equator*; then bring the other to the *Meridian*, and note how many Degrees Difference has paſſed through the *Meridian*, for that is their Diſtance required.

Thus, I find, the Difference between *Aſſengue*, and *Caput Meduſæ*, to be about 122° ½; for *Aſſengue* (38 ½ Declination) being brought to the *Meridian*, cuts 277° 30′, *viz.* 82° 30′ from ♈ Weſtward; and *Caput Meduſæ* cuts 40° of the *Equator* Eaſtward; their Diſtance, therefore, is 122° 30.

3. If neither of the Stars lie under the ſame Degree of the *Meridian*, or Declination, then bring either of them to the *Meridian*, and elevate the Pole to the ſame Height as the Star has Declanation (that is, the ſame as you elevate the Terreſtrial Globe to the Latitude of a Place) for then the Star will be in the Zenith: Therefore, fix the Quadrant to the Zenith, over the Center of the given Star, and extend it to the other Star, and the Degrees on the Quadrant is the Diſtance required in a true Arch of a great Circle.

Note, Though the Diſtance of the Stars from each other are thus determined in Degrees, yet you are not to ſuppoſe their Diſtance is ſo many Degrees to be converted into Engliſh Miles; but it only means, that they appear ſo far diſtant under ſuch an Angle.

Thus, I find the Diſtance between *Capella* and *Cor-Hydra* to be about 79°, and between *Aldebaran* and *Sirius*, about 46° 30′, &c.

4. If the Stars be at ſuch a Diſtance from each other, that the Quadrant will not reach them, then bring either of them to the *Horizon*, and elevate, or depreſs the Pole, till the other lies alſo at the Verge of the *Horizon*, and the Degrees counted upon the *Horizon*, between Star and Star, is their Diſtance in Degrees.

Thus, between *Aldebaran* and *Cor Scorpio* you will find about 170 Degrees.

PROB. VIII.

The Latitude, Day of the Month, and Height of any Star given, to tell the Time or Hour of the Night.

Rule. Rectify the Globe for the Latitude, *&c. &c.* then fix the Quadrant in the Zenith, and move the Globe and the Quadrant together, till the Star cuts the Quadrant in the given Height; and the Index will point to the Hour.

Thus, on *January* the 21ſt (at *London*) in the Evening, I obſerved *Aldebaran* E. S. E. to be about 40° high;

I demand the Time of this Obſervation? *Anſ.* A little paſt Five in the Evening. Again, on *December* the 25th in the Evening, I obſerved *Sirrus* to be about 15° high, and at the ſame Time *Regel* to be about 28°½ high; I demand the Hour? *Anſ.* About Ten at Night; and *Aldebaran* is under the *Meridian* at the ſame Time.

PROB. IX.

To tell what Stars never riſe, and thoſe that never ſet at London.

1. Only obſerve what Stars have above 38°½ N. Declination; for all ſuch never ſet at *London*, but are always above the *Horizon*.

2. Obſerve alſo thoſe Stars that have above 38°½ S. Declination, for thoſe never riſe, but are always under the *Horizon* at *London*.

Thus, the Pointers in the *Great Bear*, *Aridef* in *Cygnus*, and many others, never ſet.

Alſo, *Canobus*, in *Argo*, *Navis* and *Pes Centaurus*, and many others, never riſe at *London*.

Note 1. From what you have been taught, *Tyro*, it is eaſy to conceive that to the Inhabitants under the North Pole no South Star can ever be ſeen; nor can the Inhabitants at the South Pole ever ſee one of the Stars in the other Hemiſphere. But,

2. The Inhabitants under the *Equator* have a pleaſant Sight of all the Stars from Pole to Pole; for they riſe and ſet with them at right Angles; therefore no Star can continue above twelve Hours above this *Horizon*.

PROB. X.

To know at any Time of the Year (in the Latitude of London*) where to find any Star, or tell the Name of any Star at Pleaſure.*

Rectify the Globe for the Day, and turn it till the Index points to the given Hour; then by a Quadrant take the Height of the required Star; or, for want of this (in a common Way of gueſſing) obſerve well what Part of the Heavens it is in; *viz.* whether E. N.E S.W. or the like, as alſo its Height as near as you can gueſs: This being done, ſet the Globe in due Order for the Day and Hour, and you will find the ſame Star on the Globe; and, by applying the Quadrant, you will find

the exact Point of the Compaſs, and the real Height the Star then has, which, though not perhaps near to what you gueſſed it at, yet, if it be any noted Star, you may aſſure yourſelf you were right, as there is no other Star of Note near it about that Height, and upon the ſame Point.

Thus, on *December* the 25th, at Eight at Night, I obſerved a bright Star (as near as I can gueſs) on the S. E. Point, and about 48° high; I would know what Star it is? *Anſ. Aldebaran.*

I rectify the Globe, and turn the Index to the Hour, and then turn the Quadrant to the given Point of the Compaſs, and looking about 48° high on the Quadrant, I find *Aldebaran* to be the neareſt bright Star by the Quadrant on that Point and Height; therefore, I conclude it is *Aldebaran.*

Alſo at three Quarters paſt Ten, the ſame Night, I ſee two very bright Stars, one on, or near, the *Meridian* about 30° high, and the other near the S. E. Point, and about 35° high; I demand their Names? *Anſ. Regel* and *Procyon* in *Canicula.*

PROB. XI.

To tell the Latitude and Longitude of the Stars.

Firſt, Obſerve whether the given Star be on the N. or S. Side of the Ecliptic; for if it be on the N. Side, elevate the N. Pole 66°½, and turn the Globe till ♋ and ♑ lie in the N. and S. Points of the *Horizon*; *viz.* the Ecliptic will be parallel, or even to the *Horizon*, and fix the Quadrant in the *Zenith:* Then keeping the Globe ſteady, turn the Quadrant till the Edge of it touches the Center of the Star, and that Degree on the Quadrant, (*viz.* the Altitude of the Star in the Latitude 66°½) is the Latitude required, and the Degree of the Ecliptic, cut by the Quadrant, reckoned from *Aries* (or rather reckoned among the Signs, as it happens) is the Longitude required.

Thus you will find *Arcturus* in *Bootes* to be about 30°½ N. Latitude, and 203° Longitude from ♈, or rather 23° of ♎. Alſo, *Alcair* is about 29°½ of N. Latitude, and 28° of Longitude in ♑.

2. *For*

2. *For any South Star.*

Elevate the S. Pole 66° ½, and fix the Quadrant in the Zenith, and apply it to the Star, as before directed, you have the Latitude and Longitude required. Thus you will find *Pes Centaurus* to have about 42° ½ of S. Latitude, and 236° Longitude from ♈, or rather 26° in ♏; and thus for any other Star.

PROB. XII.

The Latitude and Day of the Month given (ſuppoſe December 25, *at Nine at Night, at* London) *to ſet the Globe ſo as to repreſent the Face of the Heavens at that Time, and ſhew your Acquaintance the Name and Poſition of the moſt eminent fixed Stars.*

Rectify the Globe for the Latitude, and bring the Sun's Place to the *Meridian*, and the Index to twelve. Then turn the Globe to the given Hour, viz. five Minutes paſt Nine at Night, and there fix it, ſo will every Star on the Globe (if you ſet the Globe N. and S.) correſpond with, or point to, the ſame Star in the Heavens.

Thus (at *London*) I find *Capella* E. by S. about 75° high, *Caſtor* and *Pollux*, one about 40° and the other about 45° high; near the E. Point. *Procyon* below them, to the left Hand, 23° high E. S. E. *Sirius* yet lower, to the left, S. E. about 10° high; *Betelgeuze* higher, on the ſame Point, about 38° high; *Regel*, more ſouthward, about 26° high; *Aldebaran*, on the ſame Point, much higher; viz. about 53°; the *Seven Stars*, or *Pleiades*, S. nearly about 62° high; *Mencar*, S. by W. 40° high; *Aridef*, N. W. about 26° high, *&c. &c.*

PROB. XIII.

To tell the Time of the acronical *riſing and ſetting of any Star.*

DEFINITION.

1. The *acronical* riſing of a Star, is when the Star riſes juſt at Sun-ſet.

2. A Star is ſaid to ſet *acronically*, when it ſets with the Sun.

Bring the Sun's Place for the given Day, to the weſtern

tern Side of the *Horizon*, and all thoſe Stars that are on, or near the eaſtern Side of the *Horizon*, riſe *acronically*; and thoſe on the weſtern Verge of the *Horizon* ſet *acronically*.

Thus I find on *December* the 6th, that *Aldebaran* riſes *acronically*, but it ſets *acronically* on *May* the 21ſt. Alſo *Sirius* riſes *acronically* on *February* the 4th, and ſets *acronically* on *May* the 14th.

PROB. XIV.

To tell the coſmical *riſing and ſetting of the Stars in any Latitude.*

DEFINITION.

1. A Star is ſaid to riſe *coſmically*, when it riſes with the Sun.

2. A Star is ſaid to ſet *coſmically*, when it ſets at Sun-riſing.

Rectify the Globe, *&c.* and bring the Sun's Place to the eaſtern Side of the *Horizon* for the given Day; then all thoſe Stars cut by the eaſtern Verge of the *Horizon* riſe *coſmically*. The Globe ſtill remaining in the ſame Poſition, look at the weſtern Verge, or Edge of the *Horizon*, and all thoſe Stars cut by it, or that are very near it, ſet on that Day *coſmically*.

Thus I find that *Arcturus*, and two ſmall Stars in *Hercules*'s Thigh, riſe *coſmically*, *September* the 25th. Alſo two Stars in *Eridanus*, *Aſſengue* in *Lyra*, &c. &c. ſet *coſmically*. *Marhal* in *Pegaſus*, is but juſt below the *Horizon*, therefore may be ſaid to ſet nearly *coſmically*, as it will within a Day or two.

For the coſmical *ſetting.*

Turn the Globe till the Star comes to the weſtern Side of the *Horizon*, and obſerve the Degree of the Ecliptic, then cut by the eaſtern Side of the *Horizon*, for that will anſwer to the Day of the *coſmical* ſetting.

Thus *Arcturus* ſets *coſmically*, *June* the 22d. Alſo *Aldebaran* ſets *coſmically*, *December* the 20th.

PROB.

PROB. XV.

To tell the heliacal *riſing, or ſetting, of the Stars.*

DEFINITION.

1. *Heliacal* riſing, is when a Star once in the Sun's Beams gets out of them, ſo as to be ſeen at the eaſtern Verge of the *Horizon*, juſt before Sun-riſing.

2. *Heliacal* ſetting, is when a Star once in the Sun's Beams gets out of them, ſo as to be ſeen ſetting on the weſtern Side of the *Horizon*, juſt after Sun-ſet.

Note 1. This *heliacal* riſing and ſetting of the Stars is different, according to their different Magnitudes. For,

Note 2. Stars of the firſt Magnitude are ſeen riſing and ſetting when the Sun is but 12° below the *Horizon*. Stars of the ſecond Magnitude are not perfectly ſeen till the Sun is 13° below the *Horizon*. Thoſe of the third Degree, when he is 14°. Thoſe of the fourth Degree of Magnitude, when he is 15° below the *Horizon*. Thoſe of the fifth Degree, when he is 16°. Thoſe of the ſixth Degree, when he is 17°; and the *nebulous*, or ſmall ones, not till he is 18° below the *Horizon*; viz. about the beginning and ending of Twilight.

To find the *heliacal* riſing, or ſetting, the Rule is, rectify the Globe, and bring the given Star to the eaſtern Verge of the *Horizon*; then fix the Globe, and turn the Quadrant to the weſtern Side, till 12° of the Quadrant touches the Ecliptic; this done, note the Degree of the Ecliptic, that is, cut by 12° of the Quadrant on the weſtern Side (for then will the real Place of the Sun be depreſſed 12° on the eaſtern Side) for that Degree ſought in the Calendar gives the *heliacal* riſing. The ſame is to be obſerved with the Quadrant on the eaſtern Side for the *heliacal* ſetting. Thus you will find *Aldebaran* riſes *heliacally*, *July* the 4th, ſets *heliacally May* the 5th.

And *Sirius* the *Dog Star* riſes *heliacally*, about *Auguſt* the 26th *.

SECT.

* *N. B.* The Poets and others, formerly uſed to reckon their *Dies Caniculares*, or *Dog Days*, from the *heliacal* riſing of *Sirius*; but they did not agree when they ended. Some reckoned them to continue thirty or forty, and others fifty Days. However, in this they agreed, that the Weather at that Time was very ſultry and faint for five or ſix Weeks

SECT. II.

Containing ſome uſeful Problems *in Navigation.*

PROB. I.

The Sun's Declination and Hour, when he is due Eaſt given, to find the Latitude, viz. *the Elevation of the Pole.*

Rectify the Globe to the ſame Latitude as the given Number of Degrees of Declination, and fix the Quadrant in the *Zenith*; then convert the Hours that the Sun is due E. before, or after, Six o'Clock, into Degrees, and count the ſame Number of Degrees on the *Horizon* from the Eaſt Point ſouthward, and bring the Quadrant to that Degree of the *Horizon*, ſo ſhall the Degree on the Quadrant that is cut by the *Equator* be the Complement of Latitude, which taken from 90°, gives the Latitude itſelf, or Height of the Pole.

Example. Sailing *May* the 21ſt, I made an Obſervation that the Sun was due Eaſt about ſeven Minutes paſt Seven in the Morning, and his Declination 20 N. I demand what Latitude I was in?

Proceed by the Rule, you will find the Latitude to be $51°\frac{1}{2}$ nearly.

PROB. II.

Having the Sun's Azimuth *at Six o'Clock, and Declination, to find the Latitude.*

Rule. As many Degrees as are contained in the *Azimuth* given, ſo much elevate the Pole, and fix the Quadrant in the *Zenith*, and bring ♈ to the Meridian: This done, count on the Quadrant upwards, the Complement of the Sun's Declination to ninety, and bring that Degree to the *Equator*, then the Degree of the *Horizon*, cut by

Weeks after the riſing of *Sirius*. But (as it was then, ſo now) it is a ridiculous Whim; for *Sirius* does not now riſe *heliacally* till near *September*, though our Almanack-makers (for what Reaſon I know not) continue the beginning of *Dog-Days*, *July* the 30th. But, however, it is plain that *Sirius* can no ways be charged with bringing this ſultry weather; becauſe three or four thouſand Years hence he will not riſe *heliacally* till *November*, and then, perhaps, will be charged with bringing as much Cold by the ſame Rule.

the

the Quadrant, ſhall be the Complement of Latitude, counted from the S. Point, or elſe from the N. as it may happen, and the Remainder to ninety is the Latitude required; or otherwiſe, the Degrees counted from the other two cardinal Points, either E. or W. as it may happen, will give the Latitude.

Thus I find the Sun's *Azimuth*, at Six o'Clock, to be 12° 15′, and his Declination 20° 10′, What is the Latitude? Work according to the Rule, you will have the Anſwer 38° ½ Complement, that is 51° ½ Latitude required.

PROB. III.

The Sun's Amplitude and aſcenſional Difference given, to find the Elevation of the Pole and Sun's Declination.

Rule. Raiſe, or elevate, the Pole ſo many Degrees as is the aſcenſional Difference, and fix the Quadrant in the *Zenith*, and bring ♈ to the Meridian, then count on the Quadrant upwards the Complement of Altitude, and move the Quadrant till that ſame Number on the Quadrant cuts the *Equator*; and the Quadrant will cut the *Horizon* in the Degree of the Pole's Elevation, and the *Equator* in the Degree of Declination.

Example. I made an Obſervation, that the Sun's aſcenſional Difference was 27° 10′, and his Amplitude 33° 20′, I demand the Latitude and Declination?

PROB. IV.

The Sun's Altitude E. and his Declination given, to prove the Elevation of the Pole.

Rule. Elevate the Pole to the Complement of the Sun's Altitude at E. and fix the Quadrant in the *Zenith*, and bring ♈ to the *Meridian*, then number on the Quadrant of Altitude the Degree of Declination, and bringing the ſame to the *Equator*, obſerve what Degree the Quadrant cuts the *Equator* in; for its Complement to 90° is the Height of the Pole.

Example. The Sun's Declination is 20° 10′ N. his Altitude at E. (at *London*) is nearly 26°, I would know whether the ſuppoſed Latitude (51° ½) agrees herewith in Operation?

Here

Here I ſubtract 26° from 90°, and there remains 64° Complement of Altitude, and I elevate the Pole accordingly, *&c.* Then I bring ♈ to the *Meridian*, and cauſe 20° 10′ on the Quadrant to cut the *Equator*, and find it nearly 38° ½, the Complement of Latitude required; which ſubtracted from 90° gives 51° ½, the real Latitude of the Place.

PROB. V.

The Sun's Declination and Amplitude given, to find the Height of the Pole.

Rule. Elevate the Pole to the Complement of Amplitude, and fix the Quadrant in the *Zenith*, and bring ♈ to the *Meridian*, then count the Sun's Declination on the Quadrant, and bring that Degree to the *Equator*; and the Degeee of the *Equator*, cut by the Quadrant, is the Latitude required.

Example. Suppoſe the Sun's Amplitude 33° 20′, his Declination 20° 10′, what's the Latitude?

Proceed according to the Rule, you will find it about 51° 30′.

THE

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YOUNG MAN's Book of Knowledge, &c.

PART V.

GEOMETRY.

DIALOGUE I. Sect. I.

Tyro. WHAT is *Geometry*, and its Uſe?

Phil. *Geometry* ſhews the Relation or Proportion of one Line to another, or of one Angle, Curve, Arch, or Mathematical Figure to another; as alſo how to meaſure irregular Figures, by firſt turning them into equal regular Figures; it is now indeed uſed for, and conſidered only as the Science of Quantity, or Extenſion.

Tyro. From whence had *Geometry* its Riſe?

Phil. There are various Opinions concerning this, nor is it of any Signification to us; but 'tis plain from the Authority of many, that in *Egypt* it was improved in the following Manner: The River *Nile* every Year overflowed the Country, and covered the Land with Mud, which obliged the Inhabitants to ſet down Doles or large Stakes, and then they drew Marks from each and platted every Man's Property; and from this they drew Figures ſimilar to thoſe in the Mud, and by further Practice became more and more acquainted with the Relation and different Proportion of Lines, &c. and conſequently, more and more with *Geometry* itſelf.

SECT.

SECT. II.

Geometrical Definitions.

Tyro. Pleaſe to define or explain ſuch Things as are neceſſary to the Knowledge of this Science.

Phil. Things previous to be underſtood, are only ſuch Figures conſiſting of various Forms, and which have a Connexion or Dependence on one another, and ought to be got ſo by heart as to remember the Names and their Uſe at the firſt Sight. They are as follows,

Fig. 1.

1. A *Point* or *Dot* is a Thing conſidered as the very Beginning, or Formation of Motion or Magnitude, and without Parts of itſelf, as the Point A, Fig. 1.

A.

Fig. 2.

2. A *Line* is generated from a Point moving or proceeding from its firſt Place to any other Place in a direct Line, Fig. 2.

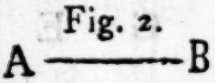


Fig. 3.

3. A *Curve* Line alſo is made by the Motion of a Point moving indirectly till it reſts at C, Fig. 3.

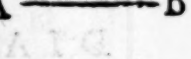
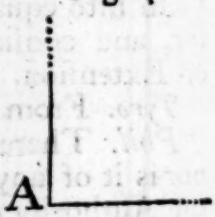


Fig. 4.

An *Angle* is made by the meeting together of two Lines in one Point, and it matters not at all whether one Line (or Leg) of the Angle be longer than the other.



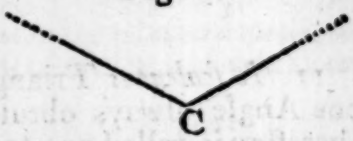
If one Line ſtands right up or perpendicular upon the other, it is called a *right Angle*, (containing 90°) or a Quarter of a Circle, as you will more plainly ſee hereafter. Thus the two Lines meeting in the Point A form a *right Angle*, Fig. 4.

5. An

Fig. 5.

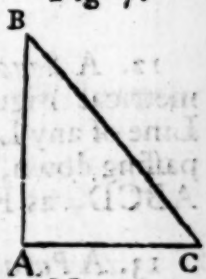
An *acute Angle* is when two Lines meet closer or nearer together than a right Angle, and is less than 90° or the Quarter of a Circle: An *acute Angle* is well represented by a Pair of Compasses opened a little Way at Random, as Fig. 5.

Fig. 6.



6. An *obtuse Angle* is when two Lines are extended wider than a right Angle, and contains more than 90° or a Quarter of a Circle, and may be represented by a Pair of Compasses extended very wide, as C, Fig. 6.

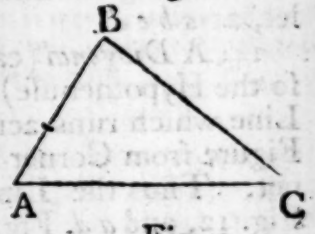
Fig. 7.



7. A *Triangle* is made by the meeting together of three Lines in three Points, as Fig. 7, 8, 9, 10, and 11.

Tyro. Have not these *Triangles* different Names, as the *Angles* before had?

Fig. 8.



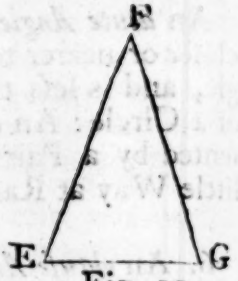
8. *Phil.* Yes, the *Triangles* take their Names from the different *Angles* they are formed from: Thus the *Triangle* ABC, (Fig. 7.) is a right angled *Triangle*, because it has one right *Angle* at A.

Fig. 9.

9. An *equilateral* Triangle has all its Sides equal, and all its Angles acute, as CDE, Fig. 9.

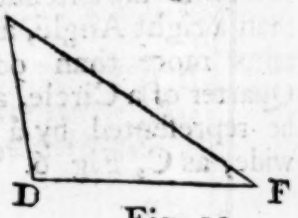
10. An

Fig. 10.



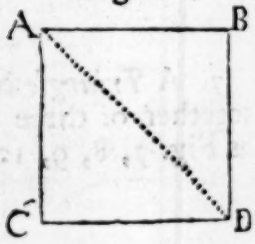
10. An *Iſoſceles*, or *equicrural* Triangle, has two Sides equal, and every Angle acute, as EFG, Fig. 10.

Fig. 11.



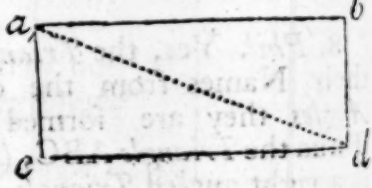
11. A *ſcalenous* Triangle has one Angle always obtuſe, and therefore is called an *obtuſe* angled Triangle, whoſe Angle D is obtuſe. See Fig. 11.

Fig. 12.



12. A *Square* is a regular Geometrical Figure, formed by a right Line of any Length, (ſuppoſing AB) paſſing down, or through the Space ABCD, as Fig. 12.

Fig. 13.



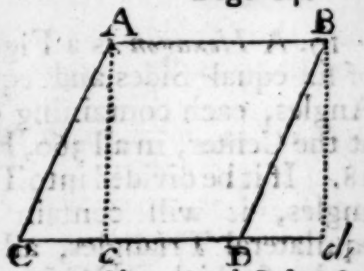
13. A *Parallelogram* (vulgarly called a long Square) is an oblong Figure, whoſe Sides are regular and parallel, as *a b c d*.

14. A *Diagonal* (called alſo the Hypothenuſe) is that Line which runs acroſs the Figure from Corner to Corner. Thus the Line AD, Fig. 12, and *a d*, Fig. 13, are Diagonals.

15. A

Fig. 14.

15. A *Rhombus* is a Diamond-like Figure, having all its Sides equal; it has two Angles obtuſe, as A and D, and two acute, as B and C, Fig. 14.



Note, A *Rhombus* is only a Square put out of its natural Order, for the *Rhombus* ABCD is equal to the Square AB *c d*, as is evident by the very Sight of Fig. 14.

Fig. 15.

16. A *Rhomboides* is a Figure repreſenting an irregular Diamond. It is equal to a Parallelogram, as the Rhombus is equal to a Square. Thus the Rhomboides A B C D is equal to the Parallelogram AB *c d*.

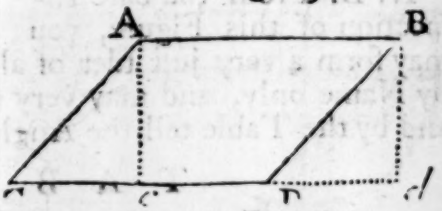


Fig. 16.

17. A *Trapezium* is a Figure of four unequal Sides and Angles, ſome being acute, and others obtuſe, as ABCB, Fig. 16.

N. B. The Diagonal BD in this Figure is moſt commonly called the Baſe, becauſe it parts the Trapezium, and makes thereof two Triangles, of which BD is a common Baſe to both.

Fig. 17.

18. A *Polygon* is a five ſided Figure, but if it has more than five Sides (provided they be unequal) it is ſtill called a *Polygon*, as ABCDE, Fig. 17.

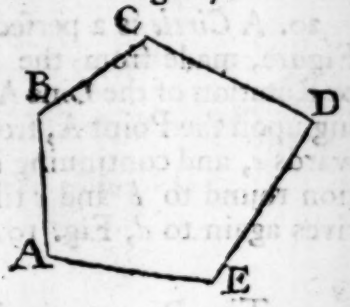
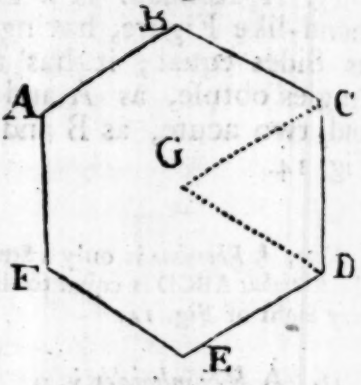


Fig. 18.



19. A *Hexagon* is a Figure of ſix equal Sides and equal Angles, each containing 60° at the Center, in all 360, Fig. 18. If it be divided into Triangles, it will contain ſix equilateral Triangles, all equal, of which DGC is one, equal and ſimilar to CDE, in Fig. 9.

N. B. From the bare Inſpection of this Figure, you may form a very juſt Idea of all that are here ſubjoined by Name only, and may very eaſily draw any of them; and by the Table tell the Angles and Area of each.

TABLE.

Names of the Figures.	No. of Sides.	Angles at the Center.	Angles at the Circumference.	Areas, the Squ. being one Inch.
A Square,	4	90.	90.	1.0000
A Pentagon,	5	72.	108.	1.7204
An Hexagon,	6	60.	120.	2.598
An Heptagon,	7	51.4285	128.5714	3.6339
An Octagon,	8	45.	135.	4.8284
A Nonagon,	9	40.	140.	6.1818
A Decagon,	10	36.	144.	7.6942
An Undecagon,	11	32.72	147.27	9.3656
A Dodecagon,	12	30.	150.	11.197

Fig. 19.

20. A *Circle* is a perfect round Figure, made from the Motion or Rotation of the Line A *d* moving upon the Point A, from *d* towards *e*, and continuing its Motion round to *b* and *c* till it arrives again to *d*, Fig. 19.

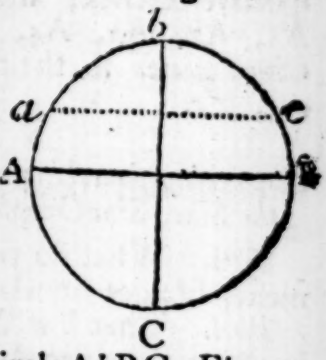
21. The *Diameter* is that Line which parts the Circle into two equal Parts, (or Semi-circles) as the Line *b* A *d*; and

and the *Radius* of a Circle is always half the Semi Diameter, or is that Line which forms the whole Circle round the Center; thus A *b*, A *c*, A *d*, A *e*, are all or either of them equal to the *Radius*.

22. A *Quadrant* is a Quarter of a Circle, as the Arch *b* or *c*, *c d*, Fig. 19.

23. A *Sector* is Part of a Circle more or leſs than a Quadrant, as the Arch *b e*, or *d e*, Fig. 19.

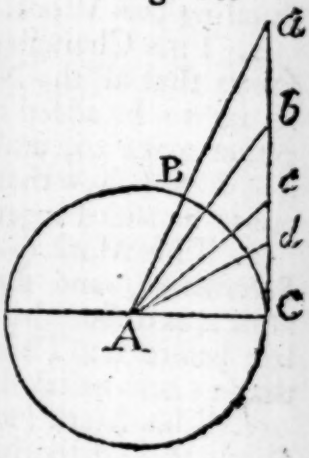
Fig. 20.



24. A *Chord* Line is that which runs from any Part of the Verge of the Circle (called the *Periphery*) to the oppoſite Part; thus the Line *a c* is the *Chord* to the Arch *a b c*, or the great Arch *a* C *c*, Fig. 20.

25. A *Segment* of a Circle is a Part cut off by a *Chord* or Line; thus *a b c* is the leſs *Segment*, and *a* C *c* is the greater *Segment* of the Circle A *b* B C, Fig. 20.

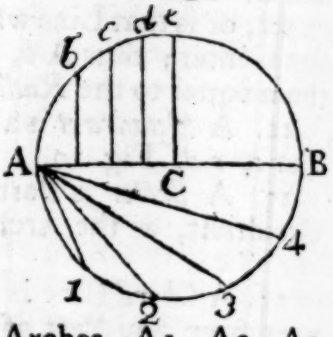
Fig. 21.



26. A *Tangent* is a Line that runs perpendicular to the Diameter, and meets it juſt at the Verge or *Periphery* of the Circle; thus the Line C*a* is a *Tangent* to the Arch BC; alſo C*b*, C*c*, and C*d*, are *Tangents* to their reſpective Arches, Fig. 21.

27. A *Secant* is a Line drawn from the Center of the Circle through the *Periphery* (or Verge) till it meets with the *Tangent*. Thus the Line AB*a*, is the *Secant* to the *Tangent Ca* and Arch BC: So alſo A*b*, A*c*, and A*d* are *Secants* to the *Tangents* that meet them, Fig. 21.

Fig. 22.



28. The natural Sine or Sines of any Arch or Arches, are Lines drawn perpendicular to the Diameter of the Circle: Thus the Line C*e*, is the right Sine of CB, ſo alſo the Lines *b c* and *d*, are Sines of their reſpective Arches; and the Lines A1, A2, A3, A4, are called *Chord* Lines to their reſpective Arches, A1, A2, A3, A4, *&c.*

SECT. III.

Concerning ſomething more of the Nature of a Circle, with the Sine, Sine Complement, and verſed Sine of an Arch.

Tyro. What do you mean by a Sine, Sine Complement, *&c.* of an Arch?

Phil. That I will explain to you in a few Minutes; but it will be neceſſary firſt that you underſtand ſome certain Marks or Signs in order for the better underſtanding this Work.

1. This Character, or Mark (+) ſignifies *more*, and ſhews that all the Numbers or Things before and after it are to be added together: Thus 14 + 12 added together make 26, and 6 + 5 + 9 + 7 make 27; ſo alſo *a* + *b* + *d* ſhew that the Numbers belonging to *a* and *d* are to be added together.

2. This Mark (−) ſignifies *leſs*, and is the Sign of *Subtraction*, and ſhews that the Quantity or Number after it is to be ſubtracted out of the Quantity or Number before it: Thus 24−15, is 24 *leſs* 15, or ſhews that 15 is to be taken out of 24, *&c.*

3. This Mark (×) is the Sign of *Multiplication*, and ſhews that all the Numbers before and after it are to be continually multiplied: Thus 5 × 14 makes 70; and 5×7×8 makes 280.

4. This Mark (÷) is the Sign of *Diviſion*, and ſhews the Number before it is to be divided by the Number after it: Thus 48÷ by 6 is 8, and 84÷7 is 12.

5. This Mark (=) is the Sign of *Equality*, and ſhews that all the Numbers or Quantities before it are equal to thoſe

thoſe after it: Thus 4+7=11; that is, 4 and 7 are equal to 11: Alſo 19−7=12 is 19 leſs 7 *equal* to 12.

6. Two Dots one over the other thus (:) ſignifies the Word *to*.

7. Four Dots thus (::) ſignify *ſo is*; and when they are put together they are the Sign of Proportion or Rule of Three Direct. For ſuppoſe 2, 4, 4, and 8 had theſe Marks thus 2:4::4:8, they are thus read, as 2 to 4, ſo is 4 to 8. *Or*, *a*:*b*::*b*:*d*, is thus read, as *a* to *b*, ſo is *b* to *d*.

8. This Character (°) ſignifies or ſtands for *Degrees*, and this (′) for *Minutes* or *Miles*.

9. This Mark (<) ſignifies an *Angle*, this (<s) *Angles*.

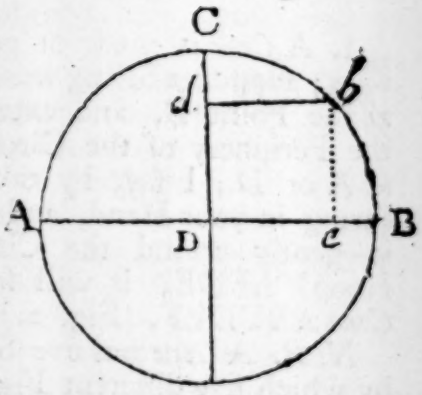
10. This (△) a *Triangle*, this (△s) for *Triangles*.

11. This (□) ſtands for a *Square*.

12. This (▭) for a *Rectangle* or *Parallelogram*.

Tyro. I ſhall endeavour to make myſelf Maſter of theſe Characters or Signs forthwith.

Fig. 1.



Phil. Obſerve then what follows, firſt, the *right* or *natural* Sine of an Arch is a Line drawn from any Part of a Circle perpendicular to the Diameter: Thus, ſuppoſe the Quadrant (or Quarter of the Circle) DCB to be divided into two Parts, viz. B*b*=42°, and C*b*=48°; then from *b* draw the perpendicular Line *eb*; ſo is *eb* the *Sine*, of 42° to the Arch B*b*; and *bd* the Sine of 48°.

2. The *Complement* of an Arch is the Remainder of any Arch to 90°. Thus the *Complement* of the Arch B*b*=42, is the Arch *b*C=48.

3. The *Coſine* or *Sine Complement* of an Arch is the *Sine* of the *Complement* of that Arch: Thus (as was ſaid before) the *Sine* of the Arch B*b* is *eb*; and the *Coſine* or *Sine Complement* to a Quadrant, is the Line *d b*, the *Sine* to the Arch C*b*.

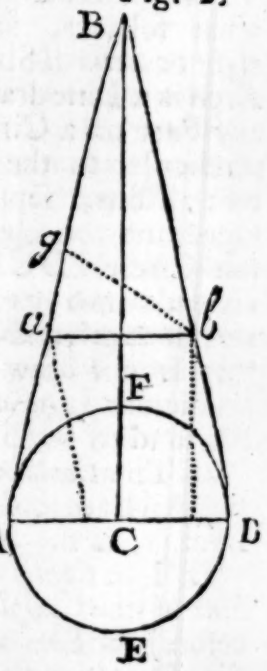
4. The *verſed Sine* is that Line, or Part of the Diameter which extends from the Periphery of the Circle to the Point where the right Sine falls upon the Diameter: Thus the Line B*e* is the *verſed Sine* of the Arch *Bb*, and C*d* is the *verſed Sine* of the Arch C*b*.

5. ☞ Always remember this, that the *verſed Sine* and *Coſine* (or *Sine Complement*) of an Arch are always equal to the Radius or Semi-Diameter: Thus the *verſed Sine* B*e* and the *Coſine d b*, (= to D*e*) are equal to DB the Radius; for *d b* = to D*e* by Inſpection; and B*e* + D*e* = DB, the Radius itſelf.

Tyro. I thank you, Sir; but before you leave this Section, pray give me ſome Account of the Nature and Property of a *Cone*.

Phil. I am ready to anſwer any Thing that lies in my Power: But a *Cone* being a ſolid Body, it is at preſent a little foreign to our Purpoſe; however, as it may be of ſome Service to you, obſerve well the following Definition of a *Cone*, both as to its Make and Generation, as well as to its Properties.

Fig. 2.



1. A *Cone* is made or generated thus; ſuppoſe a String was faſtened at the Point B, and extended to the Periphery of the Circle either at A or D; I ſay, by taking the String in your Hand, and moving it gently round the Circle (or Hoop) AFDE, it will form the *Cone* ABCDEF, (Fig. 2.)

N. B. A *Cone* has five Sections, by which five different Figures are produced, viz. A *Triangle*, a *Circle*, an *Ellipſis*, a *Parabola*, and a *Hyperbola*, as follows:

1. If the *Cone* be cut in Halves from the Point B through the Center C, that Section on the Face of the Cut will be a *Triangle*.

2. If a *Cone* be cut by the Line *a b*, parallel to its Baſe, that Section will form a true *Circle*.

3. If

3. If a *Cone* be cut by a Line parallel to its Axis, (viz. by the Line *b c*) that Section will form an *Hyperbola*.

4. If a *Cone* be cut by a Line parallel to one of its Sides (as the Line *a* C parallel to *b* D) that Section will form a *Parabola*.

5. If a *Cone* be cut obliquely, or athwart, from Side to Side, (as by the Line *b g*) that Section will form an *Ellipſis*. But this you will ſee more of hereafter.

SECT. IV.

Geometrical Theorems.

Tyro. I thank you, Sir, for theſe Inſtructions; be pleaſed to ſhew me ſomething more concerning the Nature of *Angles*, *Circles*, &c.

Phil. I will.——You remember I told you all *Angles* are part of a *Circle*, and contain ſome certain Degrees of an Arch thereof, to meaſure which is called *Trigonometry*, as you will ſee by and by under that Head. Previous to this you are to obſerve,

Fig. 1.

1. If a Circle be cut by two right Lines, as AB and CD, I ſay that the Circle will be cut into four Parts or Angles, the oppoſite of which are equal, *viz.* $a = a$ and $b = b$; alſo the *acute* or leſſer Angle *a*, with the *obtuſe* or greater Angle *b*, will both together be = to a Semi-Circle.

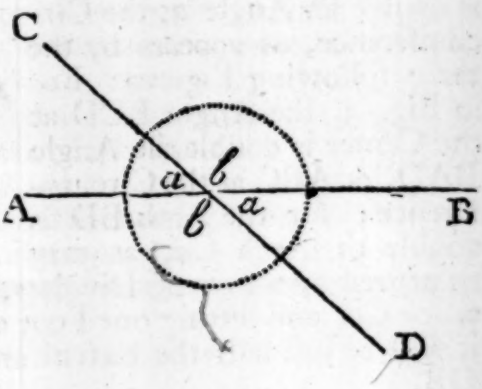
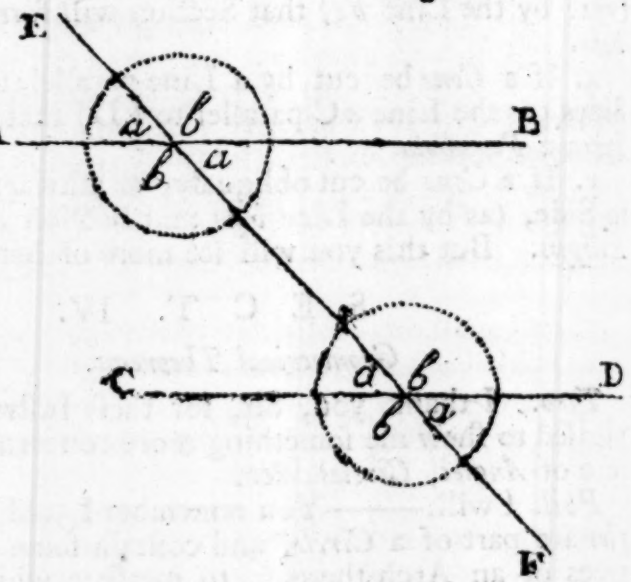
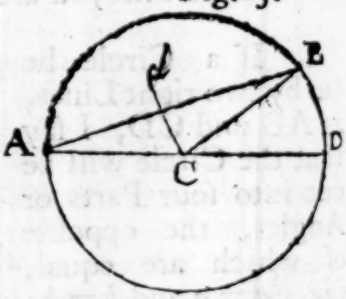


Fig. 2.



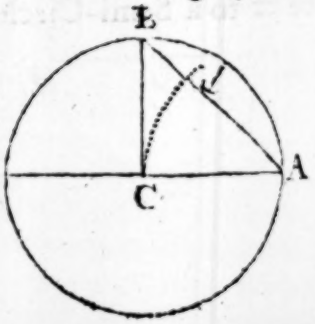
2. If two Circles be cut in the Center of each, by two Parallel Lines, then the Angles of one will be equal to the Angles of the other: Thus, *a*, *a*, *a*, *a*, and *b*, *b*, *b*, *b*, are equal to each other.

Fig. 3.



3. An Angle at the Center is double an Angle at the Circumference, as appears by the three following Figures: For in Fig. 3. the Angle BCD at the Center is double the Angle BAD, or ABC at the Circumference; for the Arch BD is double the Arch C*d*, as may be proved by a Pair of Dividers, for take off the Diſtance C*d*, and ſetting one Foot of the Compaſſes in D, it will be juſt half the Extent or Diſtance of the Arch DB.

Fig. 4.

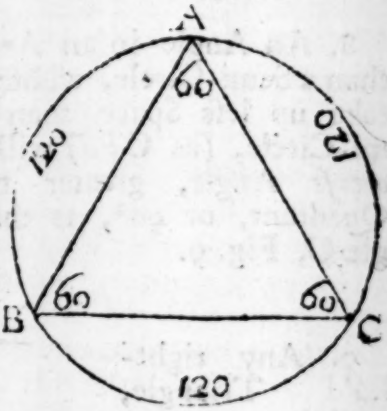


4. Again, In Fig. 4. the Angle BCA, at the Center, is double the Angle BAC at the Circumference; for the Chord or Arch BA is double the Chord or Arch C*d*.

Fig. 5.

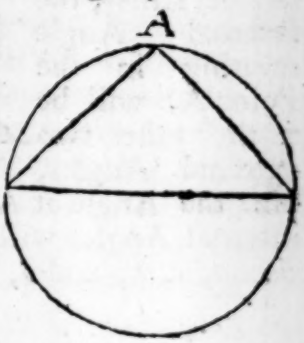
So alſo in Fig. 5. the Angle BCD, at the Center, is double the Angle BAD at the Circumference; for the Arch BD is double the ſmall Arch *bd*.

Fig. 6.



5. If an equilateral Triangle be inſcribed in a Circle, all the internal Angles are all acute and equal; and all together are equal to a Semi-Circle, or 180. AB or C are each internally =60, for 60×3=180. But externally each is =120, for 120×3=360. Fig. 6.

Fig. 7.



6. Every Angle drawn in a Semi-Circle, or whoſe Legs extend exact the Width of the Diameter of a Circle, will be a right Angle, *viz.* = a Quadrant or 90°, as the Angle A, Fig 7.

Fig. 8.

7. An Angle in an Arch greater than a Semi-Circle, whoſe Legs take up more than an Arch contained in a Semi-Circle, (as B *d c*) will be an *acute* Angle, or leſs than a Quadrant or 90°, as the Angle B, Fig. 8.

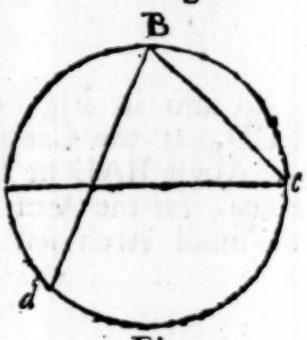


Fig. 9.

8. An Angle in an Arch leſs than a Semi-Circle, whoſe Legs take up leſs Space than a Semi-Circle, (as C *b d*) will be an *obtuſe* Angle, greater than a Quadrant, or 90°, as the Angle C, Fig. 9.

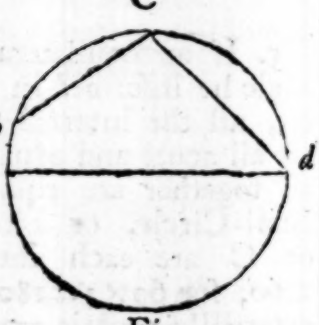


Fig. 10.

9. Any right-lin'd Triangle, made between two parallel Lines, the internal Angle meeting in the Point A, will be = the other two external Angles, *viz.* the Angle at A is = *a* and *b*: Alſo the other two internal Angles will be = to the ſaid external Angles, *viz.* *a*, *c*, *b*, and *d*, are all equal, Fig. 10.

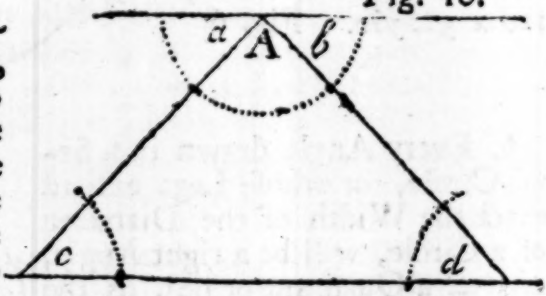
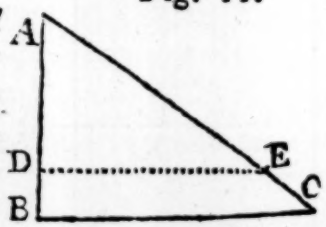


Fig. 11.

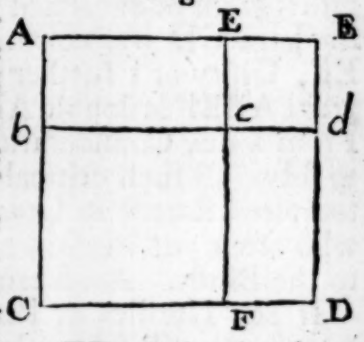
10. Any *right* or *equi-angled* Triangle (as ABC) being cut by a Line parallel to any one of its Sides (ſuppoſe by the Line DE) it will make a Triangle ADE, ſimilar to the original one ABC, and the Sides alſo will be in



Propor-

Proportion. For, as AB: AD:: BC: DE, or as AB: AD:: AC: AE.

Fig. 12.



11. If a Line AB be divided into two Parts, a Square made of the whole Line AB (*viz.* ABCD) will be equal to the Squares made of the Line AE, or *bc*, *viz.* CF *bc*, and the Square of the Line EB, *viz.* EB *cd*; together with the two Rectangles or Parallelograms made of the Parts themſelves, *viz.* AE *bc* + FD *cd*, that is, the □ ABCD is = to □ CF *bc* + the □ EB *cd* + the ▭ AE *bc* + the ▭ FD *cd*, as appears by Fig. 12.

Tyro. I think I underſtand you; but however if you can further explain it to me I ſhall be thankful.

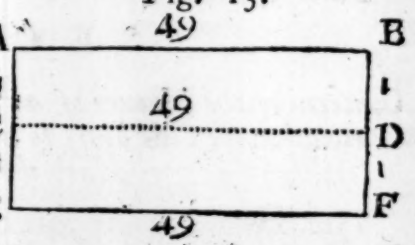
Phil. I will demonſtrate it then by common Arithmetic.

Demonſtration of Fig. 12.

Let the whole Line AB, in the foregoing Figure, be = 30 Feet; and let AE be 20, and EB 10 Feet. Now 30×30=900=□ ABCD, and 20×20=400= to the □ CF *bc*; and 10×10=100=to the ſmall □ EB *cd*. Now 30×30=900; but 20×20+10×10 = but 500, therefore the Squares made of the Parts want 400 Feet of the Square made of the whole, *viz.* the two ▭s AE *bc*, and FD *cd:* Now by the Figure *cd*=10, and AE, C *b* or F *c*=20, and 20×10=200, one of the ▭s, +200=400, both the Rectangles or ▭s, which were wanting in the Square itſelf to make up 900 Feet; does this appear plain to you?

Tyro. Sir, I underſtand it clearly.

Fig. 13.



12. If any Parallelogram have Unity (or 1) at the Ends; if the Ends be encreaſed by Unity (or 1) that Parallelogram will be double the Area of the firſt. Thus, let

the Line AB=49=CD49, and let the Ends of the Parallelogram be encreaſed as wide again; that is, ſuppoſe the Line CD was continued down, or to fall as low as EF, Unity or 1 further; then I ſay that the Parallelogram ABEF is double ABCD, viz. =ABCD+CDEF. From a due Conſideration of the Figure it will be eaſy to ſolve all ſuch critical Queſtions of this Sort, as are too often ſtarted in Company by a Set of Ignoramuſes who often put Perſons of far more ſuperior Knowledge to the Bluſh. An Example is as follows:

If 100 Hurdles or Pens will fold or keep 100 Sheep, how many will fold or keep 200? Can you do it, *Tyro?*

Tyro. Yes, ſurely, it is only a Rule of Three Sum, and I ſtate it thus, If 100 be 100, what will 200 be? Anſ. 200.

Phil. You make me laugh, *Tyro*, for it is very evident that 102 Hurdles will fold 200 Sheep.

Tyro. How can that be?

Phil. Only conſider the Nature of the Figure itſelf, and you will ſoon ſee it. Firſt I ſet down 49 Hurdles from A to B, and 49 more from C to D, which is in all 98 Hurdles, then I ſet one at each End, viz. from A to C, and from B to D, which makes 100 Hurdles in all, and the Parallelogram ABCD will fold 100 Sheep; now remove the 49 Hurdles from CD down to EF, and it is plain the Parallelogram is juſt as big again; then I place 2 more Hurdles, viz. from C to E, and from D to F, and the whole is compleated, which ſhews that 2 Hurdles more will fold 200 Sheep.

Tyro. Sir, I ſee it very evidently; and now I ſhould be obliged to you to ſhew me ſomething more of the Nature of a *right angled* Triangle, and the Proportion the Sides bear to each other.

Phil. I will.

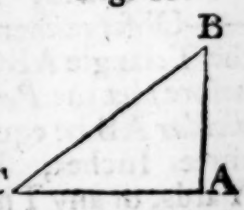
SECT. V.

Concerning the Nature of a right angled *Triangle, and the Relation one Side bears to another, and its great Uſe and Utility in ſeveral Mathematical Operations.*

Tyro. Have you any particular Names for the different Sides of a Triangle?

Phil.

Fig. 1.



Phil. Yes, three; for that Side which lies next your Breaſt, or fronting you, (viz. the Line CA) is called the *Baſe*; the Side upon which it is raiſed, or that ſtands upright to the *Baſe* (as as the Line AB) is called *Cathetus*, or *Perpendicular*; and the ſlant or longeſt Side (as the Line CB) is called the *Hypothenuſe*, or *Diagonal* Line.

Tyro. I underſtand you well. But pray what Proportion have the Sides, and the Squares of the Sides to each other.

Phil. The Sides and the Proportion to each other are found by the Square Root; but any two Sides being given, and the third Side required, the Relation of the Squares to each other is eaſily known by the following Rules.

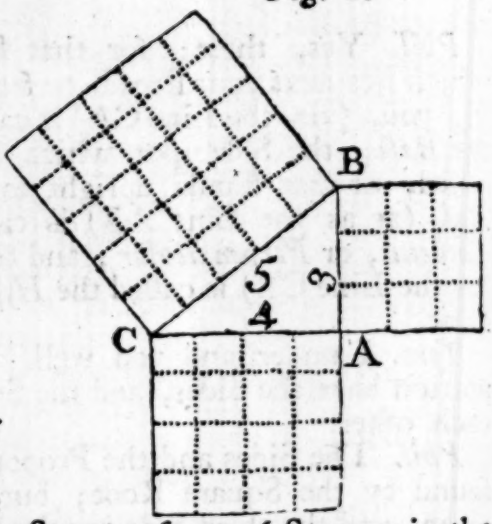
1. The Sum of the Squares of the Baſe and *Perpendicular* will be always equal to the Square of the *Hypothenuſe*.

2. The Square of the *Perpendicular* taken out of the Square of the *Hypothenuſe*, there will remain the Square of the Baſe. Or,

3. The Square of the Baſe taken from the Square of the *Hypothenuſe*, leaves the Square of the *Perpendicular*.

Tyro. I underſtand the Rules, and they appear very clear, but I ſhould be glad if you would give me a further Demonſtration by ſome Draught or Figure.

Fig. 2.



Phil. I will, *Tyro.* ——Obſerve then, In the Triangle ABC (as before) let the *Perpendicular* AB be equal to three Inches, Feet, Yards, or any Thing; ſuppoſe alſo the *Baſe* AC=4; then will the *Hypothenuſe* CB be= 5. Fig. 2.

Proof.

1. The Square of 3=9 as you ſee by the little Squares in the *Perpendicular*; and the Square of 4=16 Squares in the *Baſe:* Now 9+16=25 the Squares in the *Hypothenuſe.*

2. Again, 25−16=9, the Square of the *Perpendicular.* And,

3. From 25 take 9, there remains 16, the Square of the Baſe. Does this appear plain?

Tyro. I underſtand it perfectly.

Phil. From hence then you will eaſily diſcover how to augment any Square, and how much muſt be added to any Side to make another Square double, triple, or quadruple, to the given Square. See Sect. VI. Prob. V.

SECT. VI.

Of Geometrical Problems.

Tyro. I think I ſhall like to make Uſe of my Caſe of Inſtruments.

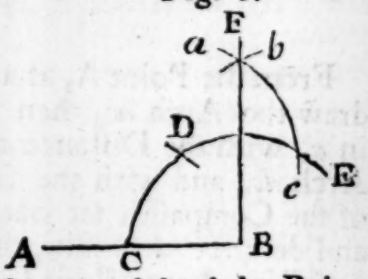
Phil I am glad you think you ſhall like to work *Problems*, for they are diverting as well as uſeful; and if you mind the Words themſelves, and proceed from Step to Step, you cannot miſunderſtand any one of them.

PROB.

PROB. I.

To raiſe a Perpendicular on the End of a Line.

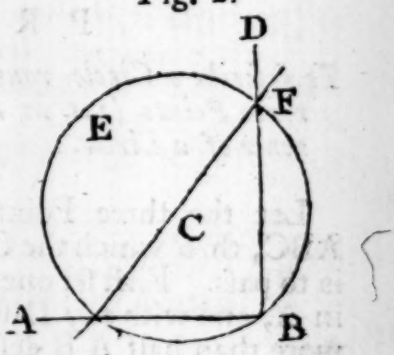
Fig. 1.



Firſt open the Compaſſes at any Diſtance ſhorter than the Line itſelf, and ſetting one Foot in B, deſcribe the Arch CDE; then ſetting one Foot in D, deſcribe the Arch *a c*; and with the ſame Diſtance ſetting one Foot in *c*, deſcribe or croſs *a c* in *b*; then from this Interſection, and thro' the Point B, draw the Line F B, and it ſhall be a true Perpendicular required.

Another Way.

Fig. 2.

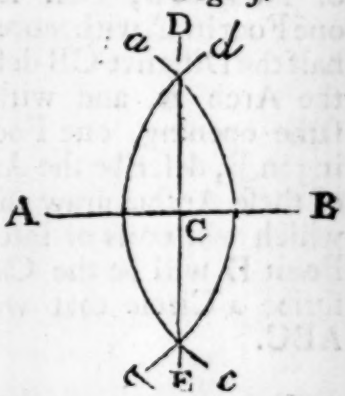


Having drawn the Line A B; place one Foot of your Compaſſes any where (ſuppoſing at C) and deſcribe the Circle A E F B to paſs thro' the Point B; this done lay a Ruler from A to C, and draw the Line A C F; then draw the Line B D thro' the Point F, and it ſhall be a true Perpendicular required.

PROB. II.

To divide a Line into two equal Parts, which ſhall be a Perpendicular to the Line both above and below.

Fig. 3.



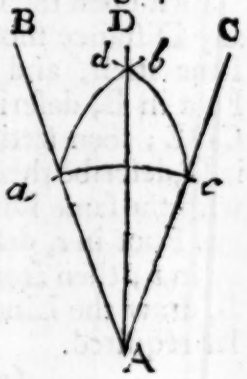
Open the Compaſſes to any Diſtance more than half the Line A B, and ſetting one Foot in A, deſcribe the Arch *a b*; then with the ſame Diſtance ſetting one Foot in B, deſcribe the Arch *c d* to interſect *a b*; then thro' theſe Interſections draw the Line D C E, and it will divide the Line into two equal Parts in C, and C D and C E will be the two Perpendiculars required.

PROB.

PROB. III.

To divide any right-lin'd Angle, or Triangle, into two equal Parts.

Fig. 4.

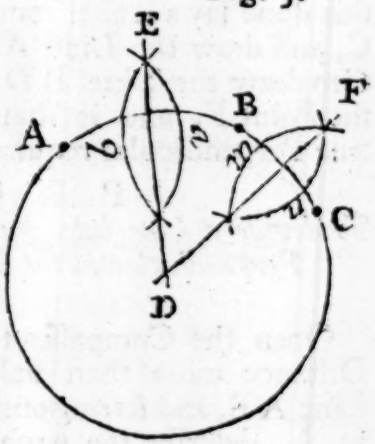


From the Point A, at any Diſtance, draw the Arch *ac*, then ſet one Foot in *a*, with the Diſtance *ac* deſcribe the Arch *dc*, and with the ſame opening of the Compaſſes ſet one Foot in *c*, and deſcribe *ab*; laſtly, thro' this Interſection draw a ſtrait Line from A to D, and it will divide the Angle ABC into two equal Parts.

PROB. IV.

To deſcribe a Circle round any Triangle, or to bring any three Points (not in a ſtrait Line) into the Circumference of a Circle.

Fig. 5.



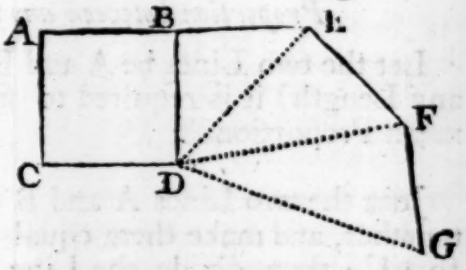
Let the three Points be ABC, thro' which the Circle is to paſs. Firſt ſet one Foot in A, and with any Diſtance more than half A B deſcribe the Arch *a*; with the ſame opening, one Foot being in B, deſcribe the Arch *b* to croſs or interſect *a*; then ſetting one Foot in C, with more than half the Diſtance CB deſcribe the Arch *m*, and with the ſame opening, one Foot being in B, deſcribe the Arch *n*; then thro' the Interſection of theſe Arches draw the two ſtrait Lines DE and DF, which will croſs or interſect each other in D, and the Point D will be the Center, from which you may deſcribe a Circle that will paſs thro' the given Points ABC.

PROB.

PROB. V.

To augment or increaſe a Square, or to find a Line whoſe Square ſhall be double, triple, or quadruple, the given Square.

Fig. 6.



Let the given Square be ABCD. Firſt ſet off the Diſtance AB from B to E, and draw DE, ſo ſhall the □ of DE be = the Double. Then ſet the ſame Diſtance (*viz.* AB, or BE) from E to F, and perpendicular or at right Angles with D E, and draw the Line D F, I ſay the □ of D F will be triple the □ of AB: Again, make F G = A B, and draw it perpendicular to D F, then draw D G, and it ſhall be a Line or Side of a □ quadruple to the □ ABCD, and thus you may go on encreaſing the Square at Pleaſure.

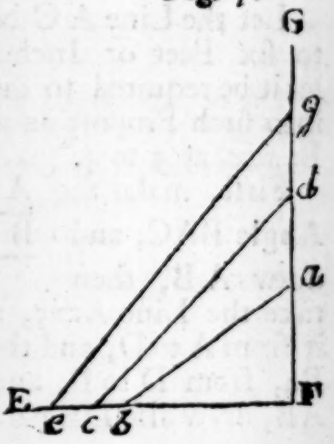
PROB. VI.

Having the Sides of two, three, or more Squares to make the Side of a Square equal to all their Squares.

Let there be four Lines ABCD, it is required to make a Line whoſe Squares ſhall be equal to the Squares of the given Lines added together.

A——
B——→
C———
D————

Fig. 7.



Firſt draw the Line E F and raiſe the Perpendicular F G, then take the ſhorteſt Line A in your Dividers, and ſetting one Foot in F, ſet from F to *a*, and the Line B from F to *b*, and then draw *a b*, whoſe Square ſhall be = the Squares of the two Lines A and B. Then ſet *ab* from F to *d*, and the Line C from F to *c*, and draw *cd*, whoſe □ is = to the Square of the three Lines A B C. Laſtly, ſet *cd* from F to *g*

and

and the Line D from F to *e*, and draw *e g*; ſo ſhall the laſt Line *e g* be the Side of a □, equal to the Squares of all the given Lines ABCD.

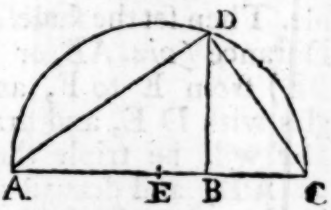
PROB. VII.

To find a Line which ſhall be a true Geometrical mean Proportion between any two given Lines.

Let the two Lines be A and B, (of any Length) it is required to find a mean Proportional.

A ——— ———
B ———

Fig. 8.



Join the two Lines A and B together, and make them equal to AC; then divide the Line AC into two equal Parts as at E, and upon E the Center deſcribe the Arch or Semi-circle A D C; then from B (*viz.* at the joining of the Lines A and B) erect the Perpendicular B D, and it will be a true Geometrical Line between the Lines A and B.

Thus ſuppoſe AC=50, A=AB=34, and B=BC=16; then will B D be =23.3 Parts, which is a Mean between 34 and 16. For multiply 34 by 16, and extract the Square Root, you will have the true Mean 23.3.

PROB. VIII.

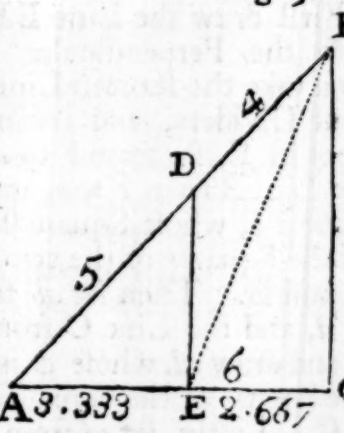
To divide a right Line into any proportionable Parts.

Let the Line A C be equal to ſix Feet or Inches, and let it be required to divide it into ſuch Proportion as A to B, *viz.* as 5 to 4.

First, make the Angle BAC, and draw A B, then take the Line A=5, and ſet it from A to D, and the Line B4, from D to B, and draw AB, draw alſo DE parallel to BC,

A 5
B 4

Fig. 9.



BC, ſo ſhall AC be = 6, viz. AE = 3.333, and EC = 2.667, and by drawing the prick'd Line EB you will have the Triangle ABC alſo in Proportion to the Triangle EBC, as the Lines are, viz. as 5 to 4.

Arithmetically.

Add the two Lines together thus, 5+4=9; then, as 9:6::5:3.333, the greateſt Part of AC; and 6—3.333 = 2.667=EC, the leſs Part.

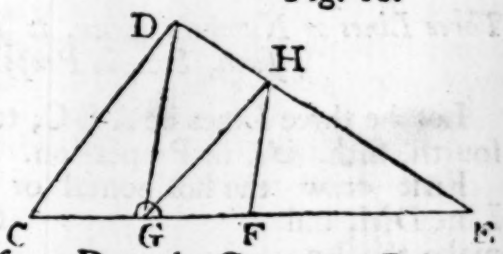
From a due Conſideration of this Law of Proportion will follow this practical Queſtion.

Two Graziers, A and B, had a Field in the Form of the Triangle CDE, at one Side of which is a Pond of Water (at G) for the Cattle to drink: But the Graziers fell out, and 'twas agreed to divide the Ground into two equal Parts, it is required to know in what Manner the Field ought to be divided ſo as each ſhall have an equal Share of the Graſs and Water. See next Problem*.

PROB. IX.

To divide a Triangle into two equal Parts.

Fig. 10.



Let the Triangle be CDE, to be divided into two equal Parts from the Point G (which repreſents a Pond, by the Queſtion in Prob. VIII.) Firſt draw the Line from D to the Center or Point at G, then divide CE into two equal Parts at F, and draw FH parallel to GD, then draw the Line GH, ſo is the Triangle divided into two equal Parts: For CDE and GHE being ſimilar Figures, CDHG is = GHE.

* See the foregoing Queſtion.

PROB.

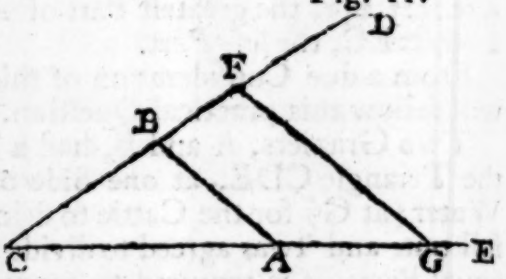
PROB. X.

Any two Numbers or Lines given, to find a third Line or Number in Proportion.

Let the two Lines be A and B, to find a third in Proportion.

A———
B———

Fig. 11.



First draw the ſtrait Line CE, (to any aſſigned Length) then draw at Random the Line CD, making therewith any Angle at Pleaſure; then take the ſhorter Line B, and ſet it from C to B, and the Line A from C to A; then take CA in your Compaſſes, and ſet it from C to F, and draw FG parallel to BA, and it is done. For, as CB:CA::CF (or CA):CG. Or, as CB:BA::CF (or CA):FG, *&c.*

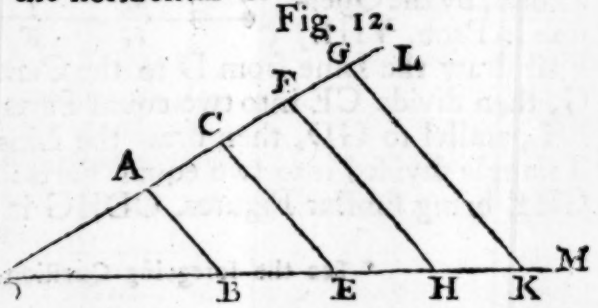
PROB. XI.

Three Lines or Numbers given, to find a fourth, fifth, or ſixth, &c. in Proportion.

Let the three Lines be A B C, to find a fourth, fifth, *&c.* in Proportion.

A———
B———
C———

Fig. 12.



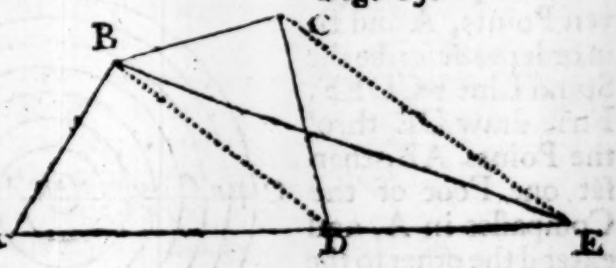
First draw the horizontal or ſtrait Line DM, and make the Angle L D M at Pleaſure; then from any Scale of equal Parts take the Line A and ſet from D to A, and the Line B ſet from D to B, and draw AB; then ſet the Line C from D to C, and draw CE parallel to AB. Then, as DA:DB::DC:DE, *&c.* Then from the ſame Scale of equal Parts ſet off (at Pleaſure) the Diſtance DF, DG, *&c.* and draw FH parallel to CE, and GK parallel

lel to FH, and 'tis done: For, as DA:DB::DF:DH; or, as DA:AB::DG:GK, &c. &c.

PROB. XII.

To reduce a Trapezium to a Triangle.

Fig. 13.

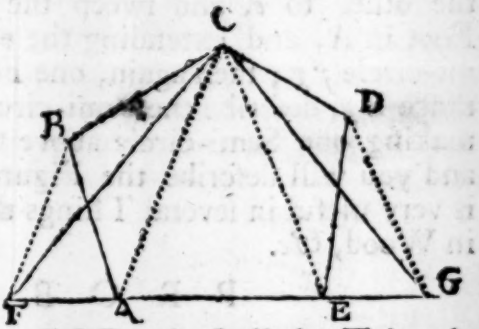


Let the Trapezium be ABCD. Firſt draw the Diagonal Line BD, and continue AD to E. and draw CE parallel to BD, and then draw the Line BE, ſo ſhall the Triangle ABE be = the Trapezium ABCD.

PROB. XIII.

To reduce an irregular Figure (or Polygon) of five Sides into a Triangle.

Fig. 14



Let the Polygon be ABCDE. Firſt with a ſtrait Ruler continue the Side AE to F and G at Pleaſure; then draw the prick'd Lines CA and CE, then draw DG parallel to CE, and BF parallel to CA, and laſtly, from the Point C draw the Line CF and CG; ſo ſhall the Triangle CFG be = the Polygon ABCDE.

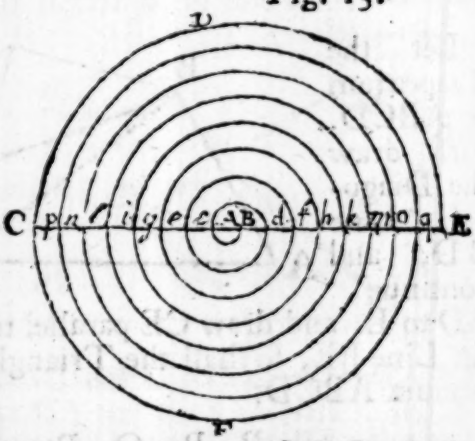
N. B. By the ſame Rule you may reduce any irregular ſided Figure to a Square or a Triangle, which is of great Uſe in Land-meaſuring; the Triangle being always equal to half a Square, of the ſame Height and Length of the Triangle, as you will more fully ſee hereafter.

PROB.

PROB. XIV.

To draw a Helix or Spiral Line (vulgarly called a Scrole) with a Pair of Compaſſes.

Fig. 15.



Let there be two given Points, A and B, in order to deſcribe the Spiral Line BCDEF. Firſt draw CE thro' the Points AB, then ſet one Foot of the Compaſſes in A, and extend the other to the Point B, and deſcribe the ſmall Semi-circle B*c*; then ſetting one Foot of the Compaſſes in B, extend the other Foot to join the firſt Semi-circle in *c*, and ſweep the Arch or Semi-circle *c d*; then place one Foot in A and extend the other to *d*, ſweep the Arch *d e*; then place the Compaſſes in B and extend the other to *e*, and ſweep the Arch *e f*; then ſet one Foot in A, and extending the other to *f* ſweep the Semi-circle *f g*; then again, one Foot in B with the Diſtance B *g*, deſcribe the Semi-circle *g h*; and thus go on making one Semi-circle above to join the other below, and you will deſcribe the Figure here annexed, which is very uſeful in ſeveral Things that require to be carved in Wood, *&c.*

PROB. XV.

To deſcribe or draw Ovals.

DEFINITION.

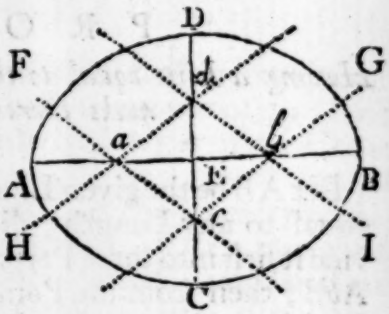
1. Ovals are long circular Figures, and vary according to their Length and Breadth; for as a Parallelogram approaches nearer to a true Square when its Length and Breadth are neareſt alike; ſo alſo do Ovals approach to or are more like to Circles, when their Diameters are more nearly alike. Therefore,

2. Ovals may be made longer or ſhorter at Pleaſure, ſome

ſome being made from Parallelograms and others from inſcribed Circles, as will more plainly appear by the following Operation.

Two Lines, AB and CD, given, to make thereof an Oval.

Fig. 16.

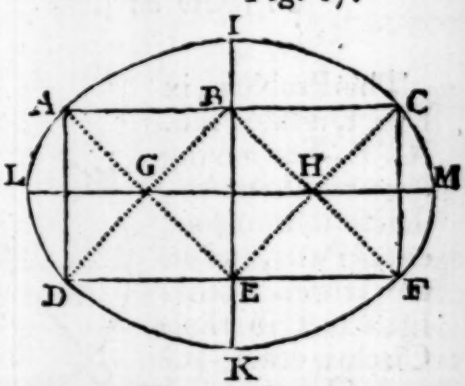


Let AB be the tranſverſe, and CD the conjugate Diameter. Firſt draw DC and AB to interſect each other in the Middle at E; then divide the Diameters AB and CD into four equal Parts at the Points A *a b* B and C *c d* D; then draw the parallel Lines *d b* and *a c*, and after that the other two parallel Lines *a d* and *c b* thro' the Points *a*, *b*, *c*, *d*; then take the diſtance D *c* in your Compaſſes, and ſetting one Foot in *c* deſcribe the Arch FDG; with that ſame Extent placing one Foot in *d*, deſcribe the Arch HCI: This done, ſet one Foot in *a*, and with the Diſtance *a* H or *a* F deſcribe the Arch HAF; and with the ſame Extent placing one Foot in *b*, deſcribe the Arch GBI, and the Oval will be compleated.

PROB. XVI.

To draw an Oval by the Help of a Parallelogram or two Geometrical Squares.

Fig. 17.



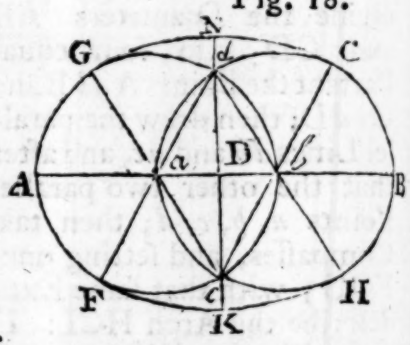
Firſt draw the Line AC, and make CF = CB, which will be half the Line AC; then draw DF parallel to AC; draw alſo AD and BE, and you will have two Squares ABDE, and BCEF; then draw the diagonal Lines AE and BF, and opening the Compaſſes with the Extent of AE or CE, place one Foot in E, and draw the Arch AC; then with the ſame Extent

Extent one Foot placed in B deſcribes the Arch DF; then ſet one Foot in G, and with the Diſtance G A ſweep the Arch DA, and with the ſame Extent from H ſweep the Arch CF, and ſo is the Oval LIMK compleated; and is allowed to be the neateſt Oval of any Sort, and is vulgarly called the Egg Oval.

PROB. XVII.

Having a Line equal to the given Length of an Oval, to make thereof a true Oval.

Fig. 18.

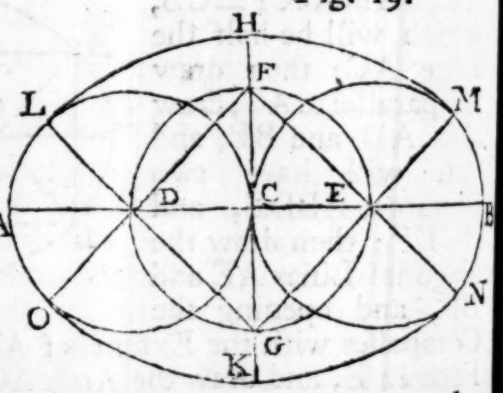


Let AB be the given Line equal to any Length; divide it firſt into three Parts, A*b*B; then from the Point *b*, with the Diſtance *b*B, deſcribe the Circle B*a*C*c*; and upon the other Diviſion at *a*, draw the Circle A*b* G *c*. Theſe two Circles will interſect one another in the Center of each, and alſo at the Points *d* and *c* draw C *b c* and F *a d* parallel; alſo G *a c* and H *b d* parallel; then from *c* with the Diſtance G*c* ſweep the Arch GNC, and from *d* with the ſame Extent ſweep FKH, and you have a true Oval.

PROB. XVIII.

To draw an Oval from three Circles.

Fig. 19.



This Problem, in Effect, is like Prob. XVI. For having drawn the Line A b, divide it into four equal Parts, and on the three Points DCE deſcribe three Circles, draw MG and O F parallel thereto; and alſo

draw

draw FN and LG parallel thereto. Then on G, with the Extent GL or GM, deſcribe the Arch LHM; and upon F with the ſame Extent deſcribe NKO. Laſtly, upon the Point D deſcribe OAL, and upon E deſcribe MBN, and the Oval is finiſhed.

OBSERVATION.

Tyro. I thank you for theſe kind Inſtructions, but pray ſuppoſe I had the tranſverſe Diameter of an Oval given, how ſhall I be able to tell the Length of the Conjugate before I draw it.

Phil. Very eaſily, as follows: Let the tranſverſe Diameter AB (in Prob. XVII.) be=1, I ſay then the Conjugate NK will be=.756 Parts, which may be thus proved. Take any Number whoſe Square Root, *&c.* may be had without Fractions. Let us ſuppoſe then that AB is = 12 Inches, Yards, *&c.* then will *a d* or *a b* be =4, (being $\frac{1}{3}$ of AB) whoſe Square is =16; and D*a* or D*b*=2, whoſe □ is =4: Now 16—4 = 12, whoſe ✓ is = 3.46=D*d* or D*c*. Now 3.46+3.46= 6.92=*dc*, and C*c*=A*b*=B*a*=8. Now 8 (the Diameter of the Circles) —the Line *dc*=6.92=1.08=N*d* or K*c*: And 6.92 × 1.08 + 1.08=MK 9.08. Now to reduce this to Unity as before, I ſay,

AB NK AB NK
As 12 : 9.08 :: 1 : .756, or,
AB NK AB NK
As 1 : .756 :: 12 : 9.08.

Therefore from hence you have three Numbers to find a fourth, let the Diameters be what they will.

Tyro. I underſtand it quite well; and I think I can find the conjugate Diameter to the Oval in Prob. XVIII.

Phil. That you may, if you are certain you underſtand the laſt Operation.

Tyro. Obſerve then, this Oval being drawn on three Circles, I will ſuppoſe the tranſverſe Diameter AB= 40, then will CE $\frac{1}{4}$ thereof be = 10, whoſe □ is = 100 + the □ of CF=100; both theſe are = 200, the ✓ of which is = 14.14=FE=HC; and HC + CK=HK 28.28.

28.28. Now to prove this, *Philo*, by your own Method, I ſay,

AB HK AB HK
As 40 : 28.28 :: 1 : 707

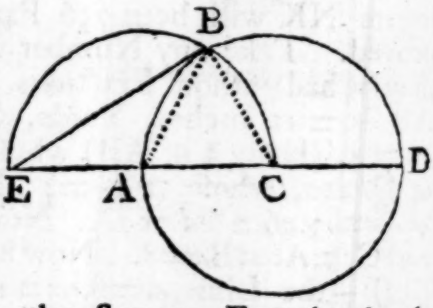
And the Angles D, E, F, G, being in a Semi-Circle, are all right; and therefore let the tranſverſe Diameter be what it will, you have the Conjugate by this one Rule:

As 1 : 707 :: any tranſverſe to its conjugate Diameter.

PROB. XIX.

To draw a true Tangent to any Circle.

Fig. 20.



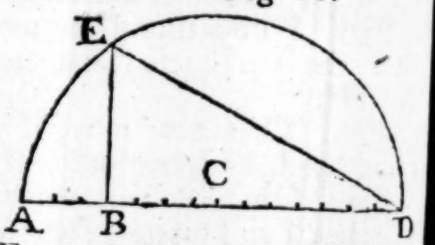
Draw the Circle CA BD, and place one Foot in A, deſcribe the Semi-Circle EBC to paſs thro' the Point at B, (called the Point of Contact) then draw the Line EB, and it ſhall be a true Tangent to the Point of Contact B; and EC is the Secant: For the Angle BEC being in a Semi-Circle, is a right Angle.

PROB. XX.

To reduce a Circle to a Square.

Note, As 7 : 22, ſo is the Diameter of any Circle to its Circumference nearly true in whole Numbers.

Fig. 21.



Divide therefore the Diameter into fourteen equal Parts, and at ſeven of thoſe Parts at C ſtrike the Semi-Circle A D; then on three or on eleven of thoſe Parts at B raiſe the Perpendicular BE; and then draw the Line DE, and it ſhall be the Side of a Square (very near) equal to the given Circle.

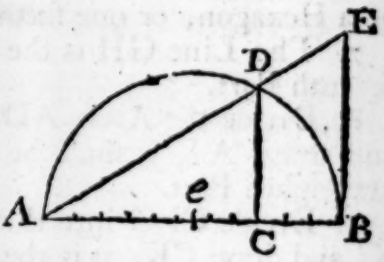
PROB.

PROB. XXI.

To reduce a Square to a Circle.

Note, When the Side of a Square is eleven, the Diameter of a Circle equal thereto is 12.41 nearly. Therefore,

Fig. 22.

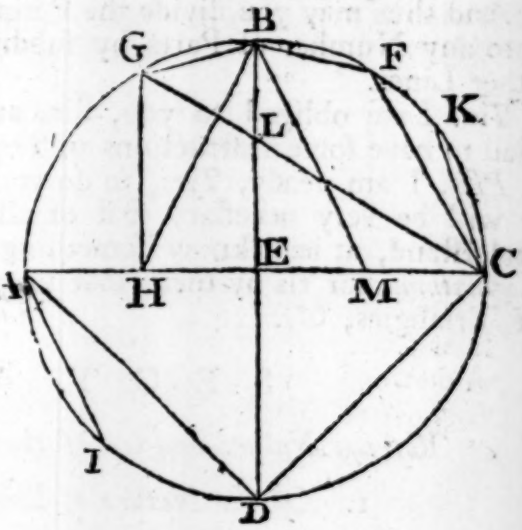


Divide the Diameter A B into eleven equal Parts, and at 5.5 of thoſe Parts at *e* deſcribe the Semi-Circle. Then at three, or at eight of thoſe Parts, erect the Perpendicular C D, and the Tangent B E parallel to it. Laſtly, draw A E, and it ſhall be the Side of a Square nearly equal to the given Circle.

PROB. XXII.

A Circle being given, to find the Side of a Triangle, Square, Pentagon, &c. or, in other Words, to divide it into any Parts, from two to thirteen.

Fig. 23.



Firſt, draw the Circle and the two Diameters A C or B D, either of which will divide the Circle into Parts.

2. Take the Radius A E, which is one ſixth Part of the Circle, and ſet it from C to F, and again from F to G, and draw G C, it ſhall be the Side of an equilateral Triangle, or one third of the Circle.

3. Draw a Line from any one of the four Quarters to the next Quarter, as the Line A D or D C, and it will be the Side of an inſcribed Square, or four ſided Figure.

4. The Diameter AC is the Side of a circumſcribed Square.

5. Let fall a Perpendicular from G to H, and draw the Line BH or BM, which ſhall be the Side of a Pentagon, or one-fifth Part of the Circle.

6. The Semi-Diameter AE or EC, *&c.* is the Side of a Hexagon, or one ſixth Part.

7. The Line GH is the Side of a Heptagon, or one ſeventh Part.

8. Divide the Arch AD into two equal Parts in I, and draw AI, it ſhall be the Side of an Octagon, or one eighth Part.

9. Divide CFG into three equal Parts at the Point K, and draw CK, it is the Side of a Nonagon, or nine ſided Figure.

10. The Line HE will be the Side of a Decagon, or ten ſided Figure.

11. The Line EL is the Side of an Endecagon or eleven ſided Figure.

12. The Line FB or BG, will be the Side of a Dodecagon, or twelve ſided Figure, being $= \frac{1}{2}$ the Semi-Diameter AE, *&c.*

And thus may you divide the Periphery of the Circle into any Number of Parts by ſubdividing any of the other Lines.

Tyr. I am obliged to you, Sir, and now I ſhall be glad to have ſome Inſtructions in *Trigonometry*.

Phil. I am ready, *Tyro*, to do you any Service; but it will be very neceſſary firſt of all that you ſhould underſtand, at leaſt know ſomething of the Nature of *Logarithms*, for 'tis by them that we work the Doctrine of Triangles, *&c.*

SECT. VII.

Of the Nature and Uſe of the Logarithms.

1. *Of the Nature of* Logarithms.

Tyr. What do you mean by the *Logarithms?*

Phil. Logarithms are artificial Numbers in arithmetical Progreſſion; firſt contrived by that indefatigable Nobleman Lord *Napier*, Baron of *Merchiſton* in *Scotland*, in

in the Year 1714, and finiſhed by our ingenious Countryman *Henry Briggs*, of *Oxford*.

Tyr. I could wiſh you could tell me the Nature of conſtructing a Table of *Logarithms*.

Phil. That would be impoſſible in this Place, nor is it ſo neceſſary as to tell you the Uſe of them; but, however, I am willing to ſatisfy your Curioſity as far as Room will allow of.

1. Let there be any Series of Numbers in Geometrical Progreſſion, and a Series of Numbers in Arithmetical Progreſſion placed over them, thus,

A. Prog. 0. 1. 2. 3. 4. 5. 6. 7. 8. 9. &c.
G. Prog. 1. 2. 4. 8. 16 32. 64. 128. 256. 512. &c.

Or,

2. A. P. 0. 1. 2. 3. 4. 5. &c.
G. P. 1. 10. 100. 1000. 10000. 100000. &c.

Theſe Numbers are increaſed tenfold in the Geometrical Progreſſion, and the Numbers above them in Arithmetical Progreſſion are the Indexes or Indices of the proper *Logarithms* belonging to them.

Tyr. I do not underſtand, Sir, what you mean by the Indexes to their proper *Logarithms*.

Phil. You will ſoon underſtand this by the very firſt Sight of the following Table.

Numbers.	Logarithms.
1.	0.000000
10	1.00000
100	2.00000
1000	3.00000
10000	4.00000
100000	5.00000, &c.

3. Now from Unity or Number 1, there is no Index or whole Number till you come to the Number 10; the Number 10, and every other Number from 10 to 100 has 1 for their Index; thus the *Logarithm* of 5 is of 7 is which have no Index, but the *Logarithms* are like Decimal Fractions without a whole Number before them; but from 10 to 100 the Index is 1. Thus the *Logarithm* of 95 is 1,9795.

4. Again, all Numbers from 100 to 1000 have 2 for

their Index and a Number beſides which look like a whole Number and a Decimal after it. Thus the *Logarithm* of 954 is 2.9795.

5. So alſo all Numbers from 1000 to 10000 will have 3 for their Index; thus the *Logarithm* of 9541 is 3.97959.

See another Example.

Numbers	Logarithms
954	2.979548
95.4	1.979548
9.54	0.979548
.0954	.9979548
.00954	.8979548
.000954	.7979548

Thus you ſee that when the Number conſiſts of 5 Places, the Index is 4; when it conſiſts of 4 Places, the Index of the *Logarithm* is 3, *&c.* always obſerve the Index is 1 leſs than the Number given.

Tyr. Now, Sir, I underſtand you; but I ſuppoſe it would be neceſſary to have a Table of *Logarithms*, would it not?

Phil. Moſt certainly, and tho' *Sherwin*'s Tables are counted the beſt (or as good as any) yet there are many others that will equally anſwer your Purpoſe.

2. *Of the Uſe of the Tables of* Logarithms.

Tyr. How may I moſt readily find the *Logarithm* to any Number?

Phil. 'Tis ſo eaſy that there needs no farther Direction than this: Turn to the Number itſelf in the Table under N, and againſt it you will find the *Logarithm*, to which prefix the Index 1 Place or Number leſs, as before directed, provided the Tables have no Index, as ſome have not. Thus you will find the *Logarithm* of 46 to be of 540 to be and 987 to be

But if you want a Decimal of a mixt Number, ſuppoſe 547.6 tenths; look for the Number 547, and carry your Eye in the ſame Line or Direction to the right Hand till you come to the Column that is under 6 at the Top of the Tables, and you will find the

the *Logarithm* to be 738463; and the given Number having 3 Places of Figures, (*viz.* 547) I conclude the Index muſt be 2; therefore the true *Logarithm* is 2.738463. The ſame is to be obſerved for any other Number or Numbers.

Note, Thus by having any *Logarithm* you may find the Number belonging to it: by ſearching the *Logarithm*, or neareſt *Logarithm* and its Correſpondent neareſt whole Number.

3. *To find the* Logarithm *of a Vulgar Fraction.*

Firſt find the *Logarithm* of the Denominator, and then take the *Logarithm* of the Numerator out of it, and you have the *Logarithm* of the Vulgar Fraction.

Example. Let the Vulgar Fraction be $\frac{54}{432}$

The *Logarithm* of the Denominator, 432 is	2.635484
The *Logarithm* of the Numerator is	1.732394
	.903090

If it be a mixt Number, reduce it to an improper Fraction, and take the *Logarithm* of the Denominator out of the *Logarithm* of the Numerator. Thus you will find $47\frac{7}{12} = \frac{571}{12}$ whoſe *Logarithm* is 1.677455.

4. *The Uſe of the* Logarithms *to multiply one Number by another.*

Add the *Logarithm* of the Multiplicand and Multiplier together, and the Sum is the *Logarithm* of the Product.

Multiply	83	*Logarithm* =	1.919078
by	12	*Logarithm* =	1.079181
Product	969	*Log.* =	2.998259

Diviſion by the Logarithms.

Subtract the *Logarithm* of the Diviſor out of the *Logarithm* of the Dividend, and the Remainder is the Quotient.

Divide 648 by 72
Logarithm of 648 is 2.811575
of 72 is 1.857332

Quotient or Anſwer 0.954243

So alſo the Quotient of 434.34 by 7.62 is 570=2.755874.

To extract the Square Root.

Divide the *Logarithm* of the given Number by 2; and the Quotient is the *Logarithm* of the Root required.

What is the Square Root of 144?

Logarithm 2.158362

2)1.079181 Anſwer.

So alſo the Square Root of 2830.24 is 53.2, whoſe *Logarithm* is 1.725911.

Cube Root.

Divide the *Logarithm* of the given Number by 3, and you have the *Logarithm* of the Root required.

I demand the Cube Root of 729?

The *Logarithm* of 729 is 2.862728

Divide by 3).954242 Anſwer

What is the Biguadrate Root of 625?

The *Logarithm* of 625 is 2.795880

Divide by 4).698970 Anſwer.

DIALOGUE II.

Of Trigonometry.

SECT. I.

Tyr. I Am afraid I ſhall not be able to underſtand any Thing of *Trigonometry*.

Phil. You always had this Fear; but, however, I commend you for it, ſince it does not conquer your Reſolution to try at that which is propoſed to you: I muſt own 'tis very modeſt in you; but yet I never knew,

knew, *Tyro*, but what you could always underſtand any Thing that has hitherto been propounded.

Tyr. But how am I to work *Trigonometrical* Queſtions?

Phil. By the *Logarithms* as I ſaid before; but you muſt find out the different *Angles*, *Sines*, *Tangents*, and *Secants*, by meaſuring them upon a Scale of Chords, Signs, and Tangents; though the beſt Inſtrument is a *Sector*, becauſe you may then draw your Circles larger or ſmaller at Pleaſure.

Tyr. But I don't know at preſent what a *Sector* is, and how I can know its Uſe?

Phil. I ſhall ſhew you the Uſe of this, and ſeveral other Inſtruments, by and by; but however, I will give you here a little Idea of it, which will be of ſome Service.

Of the Sector.

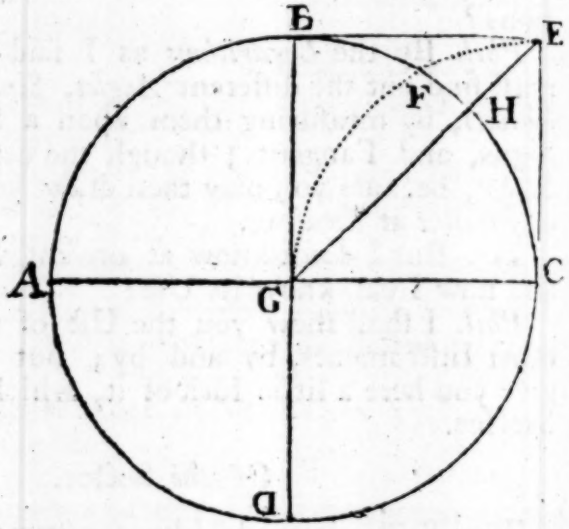
The *Sector* is made like a common Rule, but of various Sizes, ſome being (when ſhut) 6, others 8, 9, or 12 Inches long, which are called 6 or 12 Inches in Radius.

As there are a Variety of Lines upon this Inſtrument (of which I ſhall more fully treat of hereafter) it will be ſufficient for the preſent to ſpeak only of the Line of *Lines*, *Chords*, *Signs*, and *Tangents*, as follows:

1. The Line of *Lines* (marked L) runs from 1 to 10, and you may call the firſt 1 Ten, and then 2 will be 20; 3, 30, &c. to 100.
2. The Line of *Chords* (marked C) runs from 1 in the Center to 60.
3. The *Sines* (marked S) begin with 1 and end at 90. And
4. The *Tangents* (marked T) run from 1 to 45.

N. B. Here you are particularly to obſerve, that any Circle being deſcribed at Pleaſure, the Radius is called, or is = 60°. That is, let the Sector be ſhut or opened at Pleaſure, then ſet one Foot of the Compaſſes in a little Braſs Point on the Chords, and extend the other Point to 60 on the other Leg of the Sector, and with that Diſtance deſcribe any Circle, then that ſame Diſtance will reach from 90 to 90 on the Sines, and from 45 to 45 on the Tangents.

Tyr. I heartily thank you, Sir, but could wiſh you would demonſtrate it to me by ſome familiar Example.



Philo. Obſerve then I ſay the *Chords* of 60°, the *Sine* of 90°, and the *Tangent* of 45°, are all equal. For deſcribe the Circle ABCD, then take the Radius AG or GC, and open or ſhut the *Sector* till AG or CG will reach from 60 to 60 on the *Chords* croſs-ways, or from Leg to Leg; with this Diſtance make a little Daſh at F, ſo will CF be the *Chord* of 60.

2. Biſect the Quadrant BC 90, and make CH=45°, and draw the *Secant* GHE.

3. Draw the *Tangent* BE or CE; I ſay then that the *Chord* of 60°, *viz.* CF, the *Tangent* of BH or Ch=45°, and the *Sine* of 90°, *viz.* GB or GC, are all equal to *Radius*, and conſequently equal to one another. Do you underſtand it now?

Tyr. Yes, Sir, very plainly.

Phil. Then we will proceed to ſome practical Operations.

SECT. II.

Plain Trigonometry.

Tyr. If there be any Thing more neceſſary for me to know, dear *Philo*, let me beg you will explain it to me.

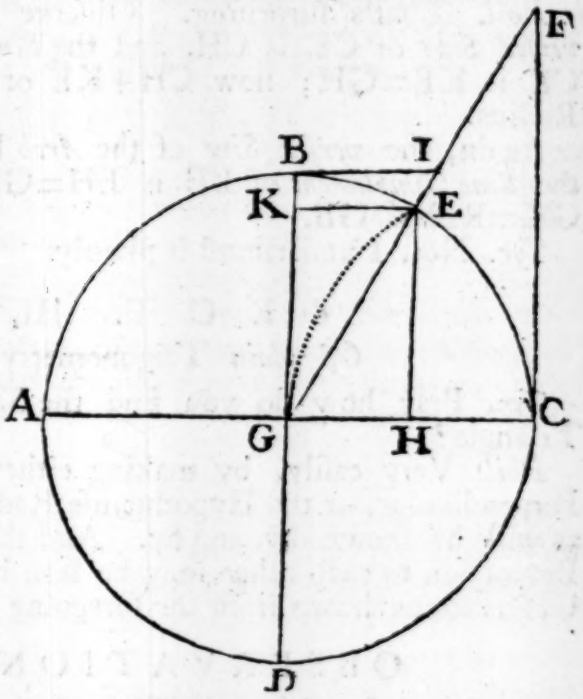
Phil. I think there is no great Neceſſity, but however, perhaps a full drawn Scheme to unfold more of the

the Nature of *Sines*, *Tangents*, &c. may not be amiſs: What ſay you?

Tyr. Sir, I return you Thanks for your Care.

Philo. Obſerve then,

Take the *Sector*, and open or ſhut it till the Line of *Chords* from 60° to 60° croſsways be made = to AG or CG (or if you like it better any other Diſtance at Pleaſure) then with one Foot of the Compaſſes in C, with the Diſtance CG, deſcribe the little Daſh at E, which is the *Chord* of 60°.



2. From C raiſe the Perpendicular CF, it ſhall be the *Tangent* of 60°.

3. From the Center G draw GF through E, and GF ſhall be the *Secant* of 60°.

4. Let fall the Perpendicular EH, and it ſhall be the *Sine* of 60°.

5. The Line HC is the *verſed Sine* of 60°.

Again,

The remaining Part of the Quadrant to 90, *viz.* BE is =30°, for CE 60° + EB 30 = 90. Now the Sine of BE is KE, which is the Coſine of CE; BI is the Tangent of 30, which is the Co-tangent of CF, and GI is the Secant of 30, and BK is the *verſed Sine*.

N. B. Pray remember that the *verſed Sine* and *Sine Complement*, are equal to the Radius or Semi-Diameter.

Do you underſtand it?

Tyr. I underſtand it very well, except that I cannot ſee at preſent that the *verſed Sine* and *Sine Complement* are equal to the Radius.

Phil. That's ſurpriſing. Obſerve then firſt the *verſed Sine* of CE is CH, and the *Sine Complement* of CE is KE=GH; now CH+KE or GH=GC the Radius.

Again, the *verſed Sine* of the *Arch* BE is BK, and the *Sine Complement* of BE is EH=GK; now BK+GK=Radius GB.

Tyr. Now I underſtand it plainly.

SECT. III.

Of plain Trigonometry.

Tyr. Pray how do you find the Sides of a plain Triangle?

Phil. Very eaſily, by making either the Baſe, the Perpendicular, or the Hypothenuſe Radius of a Circle, as will be ſhewn by and by. And the Relation and Proportion to each other may be ſeen by the following Obſervations drawn from the foregoing Figure.

OBSERVATION I.

As the Coſine is to the Sine, ſo is the Radius to the Tangent, *viz.* As KE:EH::GC:CF, or as HE:KE::GB:BI.

OBSERVATION II.

As the Radius is to the Sine, ſo is the Secant to the Tangent, *viz.* as GE:EH::GF:CF.

OBSERVATION III.

As the Sine is to the Radius, ſo is the Radius to the Co-ſecant, *viz.* as EH:EC::EG:IG.

OBSERVATION IV.

As the Tangent is to the Radius, ſo is the Radius to the Co-tangent, *viz.* as CF:CG::CG:IB.

OB-

OBSERVATION V.

From the foregoing Obſervations it appears, that the Rectangle made by the Tangent and Co-tangent of any Arch is equal to the Square of the Radius.

OBSERVATION VI.

Every Triangle has ſix diſtinct Parts, that is three Sides and three Angles; three of which being given, the other three are eaſily found.

OBSERVATION VII.

The Angles of a Triangle are found by a Scale of Chords, and the Sides are found by a Scale of equal Parts, or by the Rule of Three in common Arithmetic.

OBSERVATION VIII.

If any Angle be given larger than 90°. and cannot be found in the Tables, then work with the Complement thereof to 180.

OBSERVATION. IX.

From the foregoing Obſervations it is very eaſy to perceive that whatever Part of a Triangle is required to be found, there is in any Table of Logarithms (particularly *Sherwin*'s) the *Sine*, *Tangent*, and *Secant*, of ſuch a Triangle ready calculated, and that if the Sides be given in Miles, Rods, Yards, Feet, or Inches, and the Angles to any Degree; that the Sides and Angles oppoſite to, or anſwering ſuch Sides, will always be in Proportion to each other. This being duly conſidered, any Angle, or Side of a Triangle, may be found as follows.

OBSERVATION X.

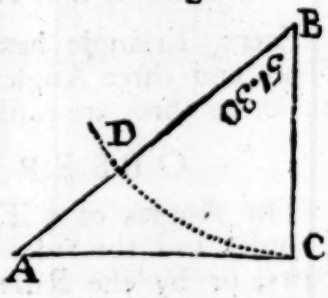
In all Caſes relating to right-angled plain Triangles, this *one* Rule ſolves all, *viz.* Let any one of the Sides be made Radius, (which of Courſe will then be the whole Sine of 90, or Semi-Diameter of a Circle) then the other two Sides will become Sines, Tangents, and Secants of ſuch Sides, according to the laſt Figure.

SECT. IV.

A farther Demonſtration of the Doctrine of right-angled Triangles, *every Side thereof being alternately made Radius.*

CASE I.

Fig. 1.



In the right-angled Triangle ABC, let the Perpendicular (or Cathetus) BC be made Radius.

Firſt ſet one Foot of the Compaſſes in B, and extend the other to C, and ſweep the Arch CD which obſerve is Part of a whole Circle, whoſe Semi-Diameter is BC). Then,

1ſt. CD is the Chord, or the Meaſure of the Angle at B.

2dly. CA 'tis evident is the Tangent of the Angle B. And,

3dly. BA is the Secant of the ſame Angle.

Therefore,

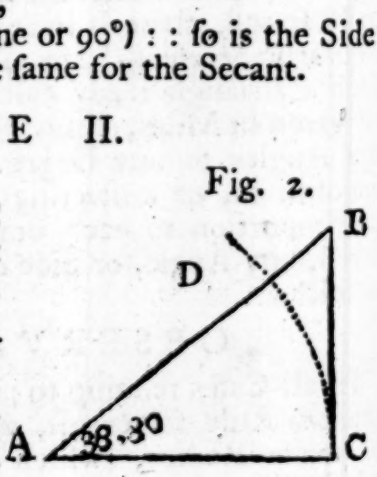
As Radius or Sine of 90° BC: BC (now Radius):: the Tangent of the Angle B: CA the Tangent itſelf.

Or,

As BC is: Radius (or Sine or 90°): : ſo is the Side AC: the Tangent Ac. The ſame for the Secant.

CASE II.

Fig. 2.



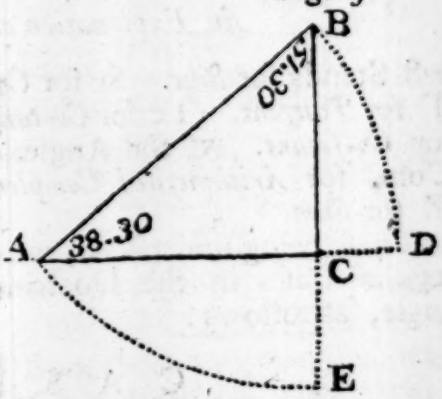
Now make the Baſe AC Radius, and ſet one Foot of the Compaſſes in A; ſweep the Arch DC, which is the Chord or Meaſure of Angle A; CB is the Tangent, and AB the Secant thereof; and the Proportion holds good as in *Caſe* I.

CASE

CASE III.

The Hypothenuſe being made Radius.

Fig. 3.



1. Set one Foot of the Compaſſes in A, and extend the other to B, and deſcribe the Arch B D, then it is evident by the Figure in *Sect.* II. that B D is the Chord, and B C is the Sine of the Angle A, and C D the verſed Side. Again,

2. Set the Compaſſes on B, and with the Extent B A ſweep the Arch A E; which is the Chord of the Angle B, and A C is the Sine thereof: Therefore 'tis evident that every Side is the Sine of its oppoſite Angle, and the Proportion is,

As Radius or Sine of the Angle at C is to the Side A B, ſo is the Sine of the ∠ B to the Side A C; or ſo is the Sine of the ∠ A to the Side B C, *&c.* In ſhort, the Proportion is the ſame as the *Rule of Three* in common Arithmetic. For the firſt and third Term, and the ſecond and fourth Term, muſt be one Name. That is, if the firſt Term be an Angle, the third muſt be an Angle; if a Side, the third muſt be a Side; and ſo alſo whatever is required muſt be your ſecond Number, and then your fourth Number will be the Anſwer to the Thing required, as in the Rule of Three. See Obſervation VII.

Tyr. I underſtand it plainly.

Phil. Then we will proceed to

SECT. V.

Practical Trigonometry, *or to meaſure or find the Sides or Angles of any Triangle.*

Tyr. How am I to find the Sides and Angles of a Triangle?

Phil. If an Angle be required, let your firſt Number be a Side; if a Side be required, let your firſt Number

Number be an Angle, or the Sine or Tangent of ſuch an Angle: Then work as in the Rule of Three Direct, by the general Rule in Problem I. &c.

An Explanation of other Signs.

S Stands for *Sine*. Sc for *Co-ſine*, or *Sine Complement*. T for *Tangent*. Tc for *Co-tangent*. Se for *Secant*. Cs for *Co-ſecant*. ∠ for Angle. ∠s for Angles. Ar. Com. for *Arithmetical Complement*. X for *Difference*. Z for *Sum*.

Theſe being underſtood, we will proceed to the ſeven regular Caſes in the Doctrine of a right-angled Triangle, as follows:

CASE I.

The two acute Angles A *amd* B, *with the Baſe* AC *being given, to find the Perpendicular* BC.

Theſe Problems are performed three different Ways, as under, but in all of them you have

A general Rule.

Add the Logarithm of the ſecond and third Term together, and from their Sum ſubtract the Logarithm of the firſt Term, and the Remainder is the Logarithm of the fourth Term (or Anſwer) required.

1. By making the Perpendicular BC Radius*.

* See Fig. 1. in the laſt Section.

As the T of the ∠ B 51° 30′ Log. 10.099395

To the Baſe AC 144 — Log. 2.158362 } add
So is Rad. or S. of 90° Log. 10.

(Having taken out the top Log.) 12.158362
To the Perpendicular BC 114.5 Log. 2.058967 Anſ.

2. By making the Baſe AC Radius †.

† See Fig. 2. in the laſt Section.

As

As Radius or Sine 90° Log. 10.

To the Baſe AC 144 Log. 2.158362 } add
So is the T of the < A 38° 30′ Log. 9.900605 }

To the Perp. BC 1145 (abating Rad.) L. 2.058967

3dly. By making the Hypothenuſe AB Radius *.

* See Fig. 3. in the laſt Section.

As the S of < B 51° 30′ Log. 9.893544

To the Baſe AC 144 Log. 2.158362 } add
So is the S of the < A 38° 30′ Log. 9.794149 }

(Abating the top Log. from this) 11.952511
To the Perpendicular BC 114.5 Log. 2.058967

Tyro. Theſe Examples appear very plain to me: But in the Explanation of the Signs you mentioned ſomething about *Arithmetical Complement*, or *Co-Arithmetic*, I cannot ſay I underſtand *that* at preſent.

Phil. The *Arithmetical Complement* is only ſubtracting the Logarithm of the Sine of any Arch out of Radius or 10.000000; or otherwiſe add ſuch Figures to the Sine as will make every Figure in the Logarithm Cyphers, and is *Co-Arithmetic.*

Thus the S of 51° 30′ Log. 9.893544
To this I add 0.106456

And the Sum makes Radius, *viz.* 10.
Or from this Radius take 51° 30′ 9.893544

Gives alſo the Arithmet. Comp. 0.106456

Tyro. I underſtand it plainly, but pray what is the Uſe of this?

Philo. In all Caſes where Radius is not in the Proportion; (as in this laſt Example) then inſtead of the firſt Term or Sine of 51° 30′, I uſe the *Arithmetical Complement* of it to 90° for the firſt Term, and ſet the other two Terms under it as before, and now add all the three Terms together, and from their Sum ſubtract Radius) and you have the Anſwer.

Thus

Thus in the foregoing Example.

As the S of < 51° 30′, Ar. Com. Log.	0.106456	add
To the Baſe AC 144	2.158362	
So is S of < A 38° 30′	9.794149	
To the Perp. BC 114.5 (abating Rad.)	2.058967	

Same by Gunter.

Always remember to extend from one Term to the Term of the ſame Name on the ſame Line; and that Extent will reach from the other Term to the Anſwer, on the ſame Line, be it Sines or Numbers, &c.

Thus I ſet one Foot of the Compaſſes in 51° 30′ in the Line of Sines, and extend the other to 38° 30′ (its Complement) in the ſame Line: This Extent I carry to the Line of Numbers, and ſetting one Foot on 144 (=AC) I turn the other backwards and find it touches 114 and 5 Parts, *viz.* 114½ the Perpendicular BC as before. Take this for a general Rule.

Tyr. I thank you, kind *Philo*.

CASE II.

The two acute Angles A *and* B, *with the Baſe* AC, *being given, to find the Hypothenuſe* AB *.

* See Figures 1, 2, 3, in Section IV.

1. By making the Baſe Radius.

As Radius	Log. 10.	
To the Baſe AC 144	2.158362	add
So is the Secant † of < A 38° 30′	10.106456	
To the Hypothenuſe AB, *viz.* 184.0 (abating Radius)	12.264818	

† Note, The Secant of any Arch or Angle is only ſubtracting the Logarithm of the Sine Complement of that Arch out of the double Radius, viz. 20.000000; thus the given Secant is 38° 30′; the Sine of its Complement is 51° 30′, viz. 9.893544, which taken out of 20.000000 leaves 10.106456, as above.

2. By

2. By making the Hypothenuſe Radius.

As the S ∠ B 51° 30′	Log. 9.893544	
To the Baſe AC 144	2.158362	} add
So is Radius	10.	
To the Hypothenuſe AB 184.0	2.264818	

3. Or by making the Perpendicular Radius.

As the T of ∠ B 51° 30′	Log. 10.099395	
To the Baſe AC 144	2.158362	
So is the Secant of ∠ B 51° 30′	10.205851	
(Abating the top Logarithm)	12.364213	
To the Hypothenuſe AB 184.0	2.264818	

CASE III.

The two acute Angles A *and* B, *with the Hypothenuſe* AB, *being given, to find the Baſe* AC.

1. By making the Hypothenuſe Radius.

As Radius or S of 90	Log. 10.	
To the Hypothenuſe AB 184.0	2.264818	} add
So is the S of ∠ B 51° 30	9.893544	
To the Baſe AC 144	2.158362*	

* Remember when you add theſe two together to ſubtract the top Logarithm for the Anſwer.

2. By making the Baſe Radius.

As the Se of ∠ A 38° 30′	Log. 10.106456	
To the Hypothenuſe AB 184.0	2.264818	
So is Radius	10.	
To the Baſe AC 144, as above	2.158362	

3. By making the Perpendicular Radius.

As the Se of Angle 51° 30′ AC.	Log. 9.794149	} add
To the Hypothenuſe AB 184.0	2.264818	
So is the T of Angle 51° 30′	10.099395	
To the Baſe AC 144	2.158362	

CASE

CASE IV.

The Baſe AC, *and Perpendicular* BC, *being given, to find the two acute Angles* A *and* B.

1. By making the Perpendicular BC Radius.

As the Perpendicular BC 114.5 Log. 2.058967

To Radius or Sine of 90 10.
So is the Baſe AC 144 2.158362 } add

To the T of the Angle B 51° 30′ 10.099395

Whoſe Complement to 90° or a right Angle is 38° 30′ the < A.

2. By making the Baſe AC Radius.

As the Baſe AC 144 Log. 2.158362

To the Radius 10.
So is the Perpendicular BC 114.5 2.058967 } add

To the T of the < A 38° 30′ 9.900605

Whoſe Complement to 90 is 51° 30′ the Angle B.

CASE V.

The Baſe AC, *and the Hypothenuſe* AB, *being given, to find the two Angles* A *and* B.

1. By making the Hypothenuſe A B Radius.

As the Hypothenuſe AB 184.0 Log. 2.264818

To Radius 10.
So is the Baſe AC 144 2.158362 } add
To the S of the < B 51° 30′ 9.893544

Whoſe Complement is 38° 30′ the < A.

CASE VI.

The Baſe AC, *and Perpendicular* BC, *being given, to find the Hypothenuſe.*

By making the Hypoth. Radius to find the Angles.

As the S of the < B 51° 30′ Log. 9.893544

To the Baſe AC 144 2.158362
So is Radius 90° 10. } add

To the Hypothenuſe AB 184.0 2.264818

CASE

CASE VII.

The Baſe AC, *and the Hypothenuſe* AB, *being given, to find the Perpendicular and the two acute Angles.*

1. By making Hypothenuſe Radius to find the Angles.

As Hypothenuſe AB 184.0	Log. 2.264818
To Radius	10.
So is the Baſe AC 144	2.158362
To the S of the Angle B 51° 30′	9.893544

Whoſe Complement is 38° 30′, the Angle A.

Or,

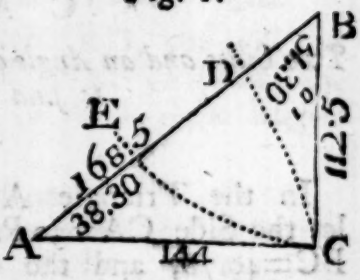
2. As Radius Log. 10.

To the Hypothenuſe AB 184.0	2.264818
So is the S of the < A 38° 30′	9.794149
To the Perpendicular BC	2.058967

Geometrically.

Any of the foregoing Caſes may be wrought geometrically, by a Scale of Chords and equal Parts.

Fig. 1.



Firſt draw the Line or Baſe AC at Random, and from any diagonal Scale, or Scale of equal Parts, take 144, and ſet it from A to C the Baſe, and from C raiſe the Perpendicular CB, then take 60° in the Line of Chords in your Compaſſes, and ſet one Foot in A deſcribe the Arch DC, and from the ſame Line of Chords take 38° 30′ and ſet from C to D, then draw A B through the Point D till it cuts the Perpendicular in B, then if you meaſure AB upon the ſame Scale, you will find it 184.0; and CE on the Chords 51° 30′.

N. B.

N. B. You may find the other Angles or Sides by the ſame Method, by making BC = 60 on the Chords, and ſtriking the Arch CE = 51° 30′ &c. as by the Figure.

Thus *Tyro*, I have given you a full Deſcription of the Nature and Property of *right-angled* Triangles in all the various Caſes; and if you now turn back to Section IV. you will more fully underſtand the Proportion of the Sides and Angles laid down in the three Obſervations thereunto belonging.

SECT. VI.

Of oblique-angled Triangles.

Tyro. I underſtand very well, kind *Philo*, what you have hitherto ſhewn me, and now beg your farther Inſtruction in *oblique Triangles*.

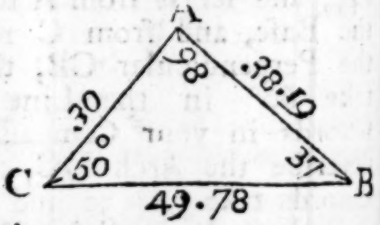
Philo. I will, but then I ſhall not work every Problem or Queſtion as I have hitherto done; yet I will not leave you wholly without Examples; for I ſhall give you the real Proportion that the Sides and Angles have to one another, and then the Operations will be eaſy, and the Work the ſame as in the foregoing Examples.

CASE I.

Two Sides and an Angle oppoſite to one of them being given, to find the other Parts.

Fig. 1.

In the Triangle ABC let the Side CA = 30 Parts, BC = 49.78, and the Angle B = 37°, to find the obtuſe Angle at A.



Proportion.

As the Logarithm of the Side CA 30 : S Angle B 37° :: Log. of Side BC 49.78 : S < A 93° Anſwer.

Note, That three Angles of every Triangle (as was ſaid before) are equal to two right ones, or 180°: Thus 50 + 93 + 37 = 180.

CASE

CASE II.

The Angle B 37°, *the Side* AC=30, *and the Angle* C 50° *given, to find the Side* AB.

Proportion.

As the S of the Angle B 37° : Log. of the Side AC 30 :: S of Angle C 50° : Log. of the Side AB 38.19.

CASE III.

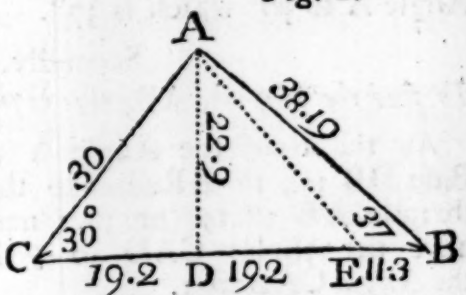
The Sides CB 49.78, *and* CA 30 *Parts, and the Angle* C 50° *being given, to find all the other Parts and Properties.*

First, Having drawn the former oblique Triangle A B C, I divide it into two right-angled Triangles by the Perpendicular AD, and then proceed as follows:

First,

The Side AC 30, the Angle at C 50°, and the right Angle D being given, 'tis required to find the Angle A, together with the Base CD, and Perpendicular DA.

Fig. 2.



Now to find the Perpendicular AD, you will first note, that the Angle at A must be = 40 (being the Complement of the Angle C 50 to a right Angle) therefore the

First Proportion.

As Radius or S 90° : to the Log. CA 30 : So is the Sine of the Angle C 50°, to the Log. of the Perpendicular AD 22.9 Parts.

Second Proportion.

As Radius or S of 90°, to the Log. AC, 30 Parts: so is the S of the Angle A 40, to the Perpendicular AD 19.2 as before.

CASE

CASE IV.

In the Triangle ABD *(in the preceding Figure) let there be given the Side* AD 22.9, *and the right Angle* D, *to find the Sides* BA *and* AB, *and the Angles* A *and* B.

First,

To find DB take CD 19.2 out of the whole Side CB 49.7, there remains the Baſe DB 30.5: So you have the two Sides of the Triangle DAB, *viz.* DB= 30.5 and AD=22.9, and the Angle at D a right one; therefore as the Log. of AD, to the Radius or S of 90, ſo is the Log. of the Baſe DB 30.5, to the Log. of the T of the Angle A 53°.

Now the Angle B is only the Complement of the Angle A to 90° which is 37°.

Secondly,

To find the Hypoth. AB, *this is the Analogy or Proportion.*

As the S of the Angle A 53° to the Log. of the Baſe DB 30; ſo is Radius to the Log. of the Hypothenuſe AB 38.19 (or 38.2 nearly). And thus you have the Angles CAD 40 + the Angles DAB 53= the Angle CAB=93.

CASE V.

The three Sides of an oblique angled Triangle being given, to find the Angles.

2. Now to find the Segment EB the Analogy is

As the Logarithm Baſe CB 49.7, to the Sum of Sides CA and AB 68.1; ſo is the Difference of the Sides CA and AB, *viz.* 8.1, to the Logarithm of the Segment EB 11.3. Now take this out of the whole Baſe CB 49.7, the Remainder is EC 38.4. of which CD is 19.2; and DE 19.2, therefore CD 19.2 taken from the whole Baſe 49.7 leaves the Baſe of the Triangle DB=30.5, and thus you have all the Sides of the two Triangles CAD and DAB; therefore,

3. *To find the Angles* A *and* B.

As the Logarithm of Hypothenuſe BC 38.1 to Radius, ſo is the Logarithm of the Baſe DB 30.5, to the Sine

Sine of the Angle A 53°, whoſe Complement to 90 is the Angle B 37.

4. *To find* A *and* C.

As the Logarithm of CA 30, to Radius, ſo is the Logarithm of CD 19.2 to the Sine of the Angle A 40°, whoſe Complement to 90 is the Angle C 50.

Proof.

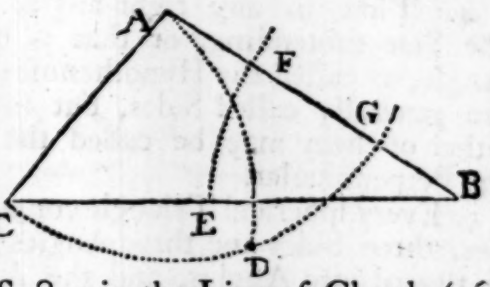
From the foregoing Operations all the Parts of the Triangle CAB are known; and though it is difficult ſometimes to tell whether the Angle at A may be obtuſe or not, yet by theſe Methods it is eaſily found; for D A B=53, C A B=40, now 53+40=93= the Angle A of the Triangle CAB. Do you underſtand it, *Tyro?*

Tyro. If you can by any Figure yet more fully demonſtrate the three Angles of an oblique-angled Triangle, I ſhould be thankful.

Philo. I will endeavour, *Tyro*, to do it; and you muſt remember that I told you, that ſometimes all the Angles will be acute, and never but one obtuſe, which will always be the Angle oppoſite the longeſt Side; and all of them will be =180°; and you may find each Angle as in other Triangles, by making each Side Radius (on any Scale of Chords) as by the following Figure.

EXAMPLE.

I demand the Angles A, B, and C, ſeparately, of the Triangle ABC.



Firſt, I take the Line AC in my Compaſſes, and make it a Parallel of 60 on the Sector in the Line of Chords (of on a ſmall Scale) and ſweep the Arch AD; and with the ſame Extent, one Foot in B ſweep the Arch EF; then take AD and meaſure it on the ſame Scale, you will find it 49° 15′, and E F 33° 15′; that is, the Angle C is 49° 15′ + the Angle B 33° 15′ is =82° 30′; therefore the Angle A, *viz.* the Arch CG, will be found to be 97° 30′, for 97° 30′+82° 30′=180.

Note,

Note, You cannot meaſure CG at once, being above 60; therefore prick off 60° from CG to D, and make a Dot in the Arch CG at D; and then take the Remainder DG, and you will find it 37° 30′: Or make a Dot at Random, any where in the Arch CG, and meaſure the two Parts ſeparately, you will find it the ſame, *viz.* 97° 30′.

SECT. VII.

Of Spherical Triangles.

Tyr. What do you mean by a *Spherical Triangle*, and how is it made?

Phil. 1. A ſpherical Triangle is a Part of the Surface of a Sphere or Globe; formed or made by the Interſection of three Arches of a Circle, drawn upon, and interſecting each other on the Surface thereof; and as the Sides of *right-lined* Triangles are meaſured by a Scale of equal Parts, theſe are meaſured by a Scale of equal Degrees and Minutes or Miles.

2. *Great Circles* are ſuch as cut the Sphere or Globe in two equal Parts; ſuch are the Equator, the Ecliptic, the Horizon, &c.

3. Every ſpherical Triangle is either right, or elſe oblique angled.

4. That in any right-angled ſpherical Triangle, the Side ſubtending, or that is oppoſite to the right Angle, is called the Hypothenuſe; the other two Sides are generally called Sides, but for Diſtinction's Sake either of them may be called the Baſe, and the other the Perpendicular.

5. Every ſpherical Triangle contains ſix diſtinct Parts, *viz.* three Sides and three Angles; and the Sides may be turned into Angles, and the Angles into Sides, as will be demonſtrated by and by.

5. What was ſaid in plain Trigonometry, ſtands here for a general Rule, *viz.* that the Radius is a *Mean Proportional* between the Tangent of an Arch, and the Tangent Complement of the ſame Arch. See Sect. III. and IV.

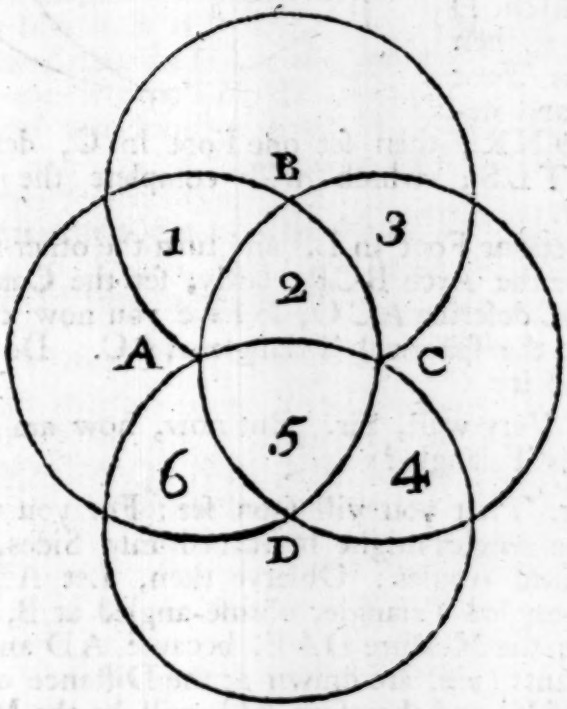
7. The Sines of the Angles of ſpherical Triangles are in Proportion to the Sines of their oppoſite Sides, and

and the Sines of their oppoſite Sides to the Sines of their oppoſite Angles.

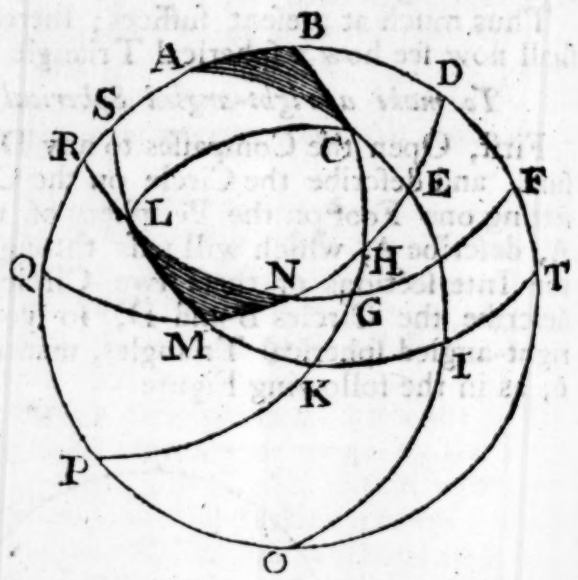
Thus much at preſent ſuffices; therefore, *Tyro*, you ſhall now ſee how a ſpherical Triangle is made.

To make a right-angled Spherical Triangle.

Firſt, Open the Compaſſes to any Diſtance at Pleaſure, and deſcribe the Circle on the Center C; then ſetting one Foot on the Periphery of the Circle C at A, deſcribe A, which will paſs through C; then, at the Interſections of theſe two Circles at B and D, deſcribe the Circles B and D, ſo you will have ſix right-angled ſpherical Triangles, marked 1, 2, 3, 4, 5, 6, as in the following Figure.



To draw a ſpherical Triangle ABC.



Firſt, upon the Center N, draw the Circle ATOQ, and make three Dots (promiſcuouſly) at ABC. 2. Set one Foot of the Compaſſes on A, and with the Diſtance NA deſcribe the Arch D N Q; then ſet one Foot in B, and deſcribe FNR; then ſet one Foot in C, deſcribe the Arch TLS; which will complete the Triangle LMN.

3. Set one Foot in L, and turn the other to B, and deſcribe the Arch BCP; laſtly, ſet the Compaſſes on M, and deſcribe ACO, ſo have you now completely formed the ſpherical Triangle ABC. Do you underſtand it?

Tyr. Very well, Sir. But now, how am I to meaſure this Triangle?

Philo. That you will ſoon ſee: For you were told, that the Angles might be turned into Sides, and the Sides into Angles: Obſerve then, Let ABC be an obtuſe-angled Triangle, obtuſe-angled at B, then will DE be the Meaſure DAE, becauſe AD and AE are Quadrants (*viz.* are drawn at the Diſtance of the Radius itſelf) and therefore FG will be the Meaſure of the acute Angle FBG, the Complement of the Angle B, and ACP is its Supplement: for P is not only = B, but all other Sides and Angles are Complements of the Triangle ABC. Thus the Side CP is the Complement of BC to a Semicircle.

4. Let

4. Let KI be the Meaſure of the Angle at C; then MN = ED, becauſe ME and ND are Quadrants, and their common Complement is NE.

5. The Side LN is = FG, becauſe NF and LG are Quadrants, and their common Complement is NG.

6. Again, LM is = KI, for KL and MI are Quadrants, and their common Complement is the Arch MK.

Thus it appears evident, that the Sides of the Triangle LMN are equal to the Angles of the Triangle ABC, taking for the greateſt Angle ABC its Complement, *viz.* the Angle DBC; and ſo by the ſame Rule the Sides of the Triangle ABC are equal to the Angles of the Triangle LMN; for the Side AC is = EI, and EI is the Meaſure of the Angle HMK, the Complement of the obtuſe Angle LMN. Again,

7. The Side AB is = RQ; now RQ is the Meaſure of the Angle MNL; and laſtly BC is = KG, which is the Meaſure of the Angle at L; for AE and CI are Quadrants; ſo are AQ and BR; BG and CK; and CE, AR, and CG are Complements of their Arches reſpectively:

Therefore the Sides of a ſpherical Triangle may be changed into Angles, and the Angles into Sides (*Q. E. D.*) which was to be proved.

OBSERVATION I.

All Sides that are equal, to a Quadrant (or Radius) are called Quadrantal; therefore, in the foregoing Figure, ND, NQ, NR, NS, &c. are Quadrantals, being equal to the Radius of the Circle itſelf every where, or being equal to the Sine of 90″, Chord of 60′, or Tangent of 45′, as was ſaid before in plain Trigonometry.

OBSERVATION II.

In *plain Trigonometry*, if two Angles are known, the third is alſo known, being the Complement to 180; but it is not ſo in ſpherical Tigonometry, becauſe the three Angles of a Spherical Triangle are greater than two right ones.

OBSERVATION III.

Where the Sides of a Triangle are all Quadrantal, and the Angles right, 'tis then called a Quadrantal Triangle, as K L C in the foregoing Figure.

Tyr. I heartily thank you, Sir. Now I ſhould be glad you would give me ſome Inſtructions in meaſuring the Sides and Angles.

Philo. I will, but it muſt be very ſhort and conciſe, therefore your Application muſt be greater.

Tyr. Pleaſe to give me an Example or two by working ſome Problems at large.

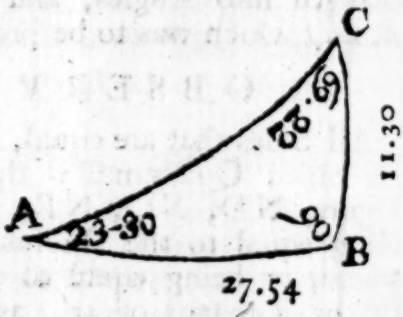
Philo. The Way and Manner of working a Problem here, being the ſame in *plain Trigonometry*; I ſhall give you only one Example, having room for no more, and by the Help of the following Table, you may work the reſt at Leiſure.

SECT. VIII.

Of the ſixteen Caſes of right-angled Spherical Triangles.

CASE I.

The Side A B (27° 45′) *and the Angle at* A 23° 30′ *being given, to find the Perpendicular or Side* B C. *Then*



As Radius or Sine of 90	10.
To the S of the Side A B 27.54	9.67018
So is the T of the Angle A 23.30	9.63830
To the Side B C 11. 30	9.30848

And ſo on for any of the other Sides, as in the following Table.

A

A SYNOPSIS, *or ſhort* TABLE *of the ſixteen Caſes of right-angled Spherical Triangles, with their Analogies or Proportions.*

N. B. Two Capitals together ſignify a Side, and one Letter ſhews the Angle.

Caſes	Given	Required	Proportions.
I	AB & A	BC	As Rad. : S. of AB :: T ∠ A : the T of BC.
II	AB & A	C	As Rad. : Sc of AB :: S ∠ A : Sc ∠ C.
III	AB & A	AC	As Rad. : Sc of A :: Tc of AB : TC of AC.
IV	BC & A	C	As Sc of BC : Rad. :: Sc of ∠ A : S ∠ C.
V	BC & C	AC	As S ∠ A : Rad. :: S of BC : the S of AC.
VI	BC & A	AB	As Rad. : Tc ∠ A :: T of BC : the S of AB.
VII	AC & A	AB	As Rad. : Sc ∠ A :: T of AC : the T of AB.
VIII	AC & A	BC	As Rad. : S of AC :: S ∠ A : S of BC
IX	AC & A	C	As Rad. : Sc of Ac :: T of ∠ : Tc ∠ C.
X	AB. BC	AC	As Rad. : Sc of BC :: Sc of AB : Sc of AC.
XI	AB & BC	A	As Rad. : Sc of AB :: Tc of BC : TC of ∠ A
XII	AC & AB	BC	As Sc of AB : Rad. :: Sc of AC : Sc of BC.
XIII	AC & AB	A	As Rad. : T of AB :: Tc of AC : Sc of ∠ A.
XIV	AC & AB	C	As S of AC : Rad. :: S of AB : of ∠ C.
XV	A & C	BC	As S of ∠ C : Rad. :: Sc of ∠ A : Sc of BC.
XVI	A & C	AC	As Rad. : T of ∠ C :: Tc of ∠ A : Sc of AC.

SECT. IX.

Of oblique-angled Spherical Triangles.

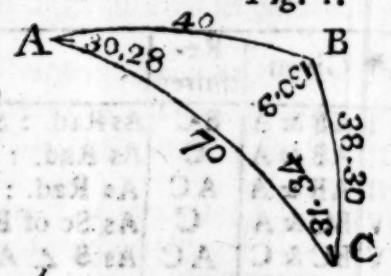
Tyr. How are oblique Spherical Triangles ſolved?

Philo. If the Things given be oppoſite the Things required, they are ſolved like right angled ſpherical Triangles, by this Rule; that the Sines of the Sides are in direct Proportion to the Sines of their oppoſite Angles.

CASE I.

Two Sides and an oppoſite Angle to one of them given, to find the other Angle.

Fig. 1.



Let AC = 70° BC = 38° 30′ the Angle A 30° 28′, to find the Angle at B.

As the S of Side BC 38° 30′,	9.794149	
To S the Angle A 30° 28′	9.705040	add
So is S of Side AC 70°	9.972986	

To S or S c of the Angle B.
From this 19.678026
Take the Top Log. and there will remain 9.883877
The Logarithm anſwering to the Sine of 49° 57′, whoſe Complement to 180° is 130° 3′ = the Angle at B, as by the Figure. And thus for all the reſt.

CASE II. Fig. 1.

Two Angles, viz. B. 130° 3′, C 31° 34′, *and the Side* AC 70, *being given; to find the Side* AB.

Analogy. As the S of the Angle B 130° 3′ : S of the Side AC 70° :: S of the Angle at C 31° 34′ : S of the Side AB 40°.

CASE III. Fig. 1.

Two Sides, viz. AC 70°, *and* AB 40°, *with the Angle* A 30° 28′ *being given; to find the Angles at* B *and* C.

RULE I.

Add the Sides AC and AB together, and take the 1-half of it, which is 55°; alſo take 1-half the Difference of AB, and of AC, *viz.* 15°, as alſo 1-half the Angle A, *viz.* 15° 14′. Then as S of 1-half the Sum of the Sides AC, and AB, (*viz* 55°) : the S of 1-half the Difference 15° :: T c of 1-half the Angle A, *viz.*

15°

15° 14′: T of 1-half the Difference of the Angles B and C 49° 14′ 30″.

Again,

2. As the Sc of 1-half Sum of Sides AC and AB, *viz.* 55° : Sc of 1-half their Difference 15° :: Tc of 1-half the Angle at A 15° 14′ : T of 1-half the Sum of the Angles B and C 80° 48′ 30″.

3. Add the 1-half the Difference of the unknown Angles B and C 49° 14′ 30″ to the 1-half the Sum 80° 48′ 30″, it gives 130° 3′, the Angle at B; and 49° 14′ 30″ taken from 80° 48′ 30″, gives the Angle C = 31° 34′, as above.

CASE IV. Fig. 1.

Two Angles, viz. A 30° 28′, *and* B 130° 3′, *and their interjacent Side* AB 40° *being given; to find the other Sides* BC *and* AC.

Take the Sum and Difference of the two Angles, and you will find the Sum 160° 31′, whoſe 1-half is 80° 15′ 30″. Their Difference 99° 35′; whoſe 1-half is 49° 47′ 30″. The Side AB is 40°, whoſe 1-half is 20°.

Then the Analogy is,

1. As S of 1-half the Sum of the Angles A and B, 80° 15′ 30″ : S of 1-half their Difference 49° 47′ 30″ :: T of 1-half the Side AB 20° : T of 1-half the Difference BC and AC 15° 45′. Again,

2. As the Sc of 1-half the Sum of the Angles A and B 80° 15′ 30″, to the Sc of 1-half their Difference 49° 47′ 30″ :: T of 1-half the Side AB 20° : T of 1-half the Sum of the Sides BC and AC, *viz.* 54° 15′.

3. Add therefore 1-half the Difference of the Sides BC and AC 15° 45′ to 1-half their Sum 54° 15′, and it gives 70° for the Side AC; but if deducted leaves the leſs Side BC 38° 30′.

CASE V. Fig. 1.

Two Sides, viz. AC 70° *and* BC 38° 30′, *and the Angle* A 30° 28′, *to find the Side* AB.

N. B. By Caſe the firſt, the < B is found = 130° 3′

Rule. Take the ½ Sum of the two Angles, *viz.* 160° 31′,

31′, which is 80° 15′ 30″, and ½ their Difference, which is 49° 47′ 30″, and ½ the Difference of the Sides, which is 10° 45′. Then,

As the S of ½ Difference of the ∠s B and A 49° 47′ 30″: the S of ½ their Sum 80° 15′ 30″:: the T of ½ Difference of the Sides AC and BC: T of ½ the Side AB 20°, which doubled gives 40° = the Side AB.

CASE VI. Fig. 1.

Two Angles, viz. A 30° 28′, B 130° 3′, *and the Side* AC = 70° *being given; to find the Angle at* C.

N. B. First, by Case 2. find the Side BC = 38° 30′.

1. Add the Sides AC and BC together, they make 108° 30′, whose ½ is 54° 15′; the Difference of the Sides is 31° 30′, whose ½ is 15° 45′.

2. The Difference of the ∠s B and A is 99° 35′, whose ½ is 49° 47 30′. Then the Proportion is,

As the S of ½ the Difference of the Sides BC and AC 15° 45′: ½ the Sum of the Sides of BC and AC 54° 15′:: T of ½ the Difference of the <s B and A 49° 47′ 30″: T of ½ the ∠ at C 15° 47′; whose Double is 31° 34′, the < at C required.

CASE VII. Fig. 1.

Two Sides AC 70° *and* BC 38° 30′ *and the oppoſite Angle* A 30° 28′ *being given; to find the Angle* C.

First, By Case 1. I find the ∠ at B 130° 3′.

1. The Difference of the Angles B and A is 99° 35′, whose ½ is 49° 47 30″.

2. The Sum of the Sides AC and BC is 108° 30′, whose ½ is 54° 15′; their Difference is 31° 30′, whose ½ is 15° 45′. Then,

3. As S of ½ Difference of the Sides, *viz.* 15° 45′: S of ½ the Sum of the Sides 54° 15′:: T of ½ the Difference of the <s B and A, *viz.* 49° 47′ 30″: T of ½ the ∠ at C 15° 47′, which doubled gives 31° 34′.

CASE VIII. Fig. 1.

Two Angles. viz, 31° 34′, *and* B 130° 3′, *and the oppoſite Side* AC 70° *given; to find the Side* BC.

First, I find the Side AB (by Case 2.) to be 40°.

1.

1. The Sum of the 2 <s B and C is 161° 37′, whoſe ½ is 80° 48′ 30″; their Difference is 98° 29′, whoſe ½ is 49° 14′ 30″.

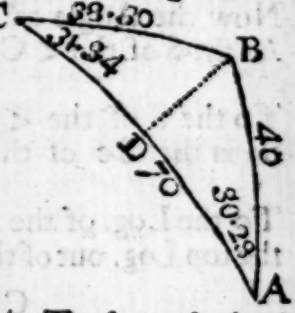
2. The Difference of the Sides AB and AC is 30°, whoſe ½ is 15°. Now,

As S of ½ the Difference of the ∠s B and C 49° 14′ 30″ : S of the ½ S of the ſaid ∠s 80° 48′ 30″ :: T of ½ the Difference of the Sides AB and AC, *viz.* 15° : T of ½ Side BC 19° 15′, which doubled gives 38° 30′, the Side BC.

CASE IX.

In the Triangle ABC, *let there be two Sides*, CB 38° 30′, *and* AC 70°, *and the Angle* C 31° 34′; *to find the Side* AB.

Fig. 2.

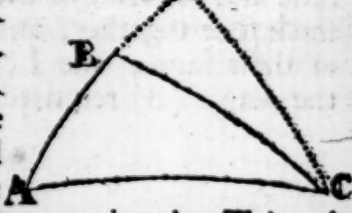


This is done two Ways, either by letting fall a Perpendicular within or without the Triangle.

1. Let fall the Perpendicular BD, which will divide the Triangle ABC into two Rectangulars ADB and BDC; then may the Side AB be found as follows. As Rad : Sc of the included < C :: T of the leſs Side CB 38° 30′ : T of a 4th Arch 34° 8′, (which remember to reſerve) whoſe Complement to 90° is 55° 52′, called the reſidual Arch.

2. As Sc of this 4th Arch 34° 8′ : Sc of the reſidual Arch 55° 52′ :: Sc of the leſs Side CB 38° 30′ : Sc of the Side AB 40°, as required.

Fig. 3.



3. N. B. That the Perpendicular may and will often happen to fall without the Triangle, as in Figure 3d annexed. Then muſt the Sides of the original Triangle be continued to make two Rectangulars, the one being included in the other, as in the Triangle ABC, in which the Perpendicular let fall will be DC falling from C on the Side AB continued, and form-

ing the two Rectangulars BDC and ADC; and therefore the Side BC may be found as in the former Directions.

N. B. If the <'s at the Baſe be both of one Kind or Name; the Perpendicular will then fall within the Triangle; but if the <'s are different, it will fall without the Triangle.

CASE X. Fig. 2.

Two Angles, C 31° 34′, B 130° 3′, *and the Side* CB 38° 30′ *being given, to find the Angle at* A.

N. B. See Fig. 1. and 2.

1. Divide the oblique Triangle ABC into two rectangled Triangles by the Perpendicular BD; this will make two different Triangles CBD and DBA, whoſe Angle CBD is 64° 19′, and the Angle ABD = 65° 44′. Now the Angle at A is thus found.

As the S of the < CBD = 64° 19′ Log. 9.954823

To the S of the < ABD 65° 44′ - - 9.959824 } add
So is the Sc of the < C 31° 34′ - - 9.930456 }

To the Log. of the ∠ at A (firſt taking the top Log. out of this Sum) *viz.* 38° 30′ 19.890280 9.935457

CASE XI.

Three Sides given, to find the obtuſe or oblique Angle B.

RULE.

Add all the Sides together; then take the Arithmetical Complement of the two leſſer Sides (which here is CB and AB) and the Sine of ½ the Sum of the Sides; and alſo the Sine of the Difference between the longeſt Side and the Half of the Sum of the three Sides; add all theſe four together, and take the Half of the Logarithm of their Sum; the Logarithm that remains will be ½ the Angle (B) required.

	See the Work.		Co. Arith.
The Side AC	70°		
The Side CB	38.30′	- -	0.191933
The Side AB	40	- -	0.205850
	148.30		
½ this is	74.15	- - Sine	9.983380
Subſtract AC	70		
Difference	4° 15′	Sine	8.869868
		Sum	19.251031
The ½ of this is			9.625515

This Logarithm 9.625515 anſwers to 65° 1′ 30″, which doubled gives 130° 3′ the ∠ at B required.

Tyr. I thank you very kindly, *Philomathes*, for this Demonſtration.

Phil. It is difficult no doubt, to be apprehended by a few Words only; and you are alſo to take Notice, that this Operation helps you to find the Beginning and End of Twilight; likewiſe the Variation of the Needle; the Sun's Azimuth, the Declination of a Wall, or any Plane in Dialling.

CASE.

CASE XII.

The three Angles, A 30° 28′, B 130° 3′, *and* C 31° 34′, *being given*; *to find the Side* AB.

N. B. See the Fig. 1. 2.

This Case is performed like the last, by converting the Angles into Sides, or the Sides into Angles.

			Co. Arith.
For let the ∠ C = 31° 34′ 26″,			
Angle at A =	30. 28. 11.		0.094920
Complement ∠ B,			
To 180,	49. 56. 49.		0.116084
Sum	111. 59. 26.		
½ this Sum -	55. 59. 43.	Sine -	9.918549
From this take ∠ C	31. 34. 26.		
Difference .	24. 25. 17.	Sine -	9.616417
	Sum - - -		19.945970
Whose ½ Sum is	- - -		9.972985

Which is the Sc of 20, which doubled gives the Side AB = 40.

N. B. If the greater Side AC were required, then the Operation would produce the Complement thereof to a Semi-circle, or 180°; therefore by subtracting it from 180°, you would have the Side AC.

DIALOGUE III.

Of ASTRONOMY.

SECT. I.

Tyr. WHAT do you mean by Astronomy?

Philo. Astronomy is that Part of the Mathemathics that teaches us the System of the Universe, by discovering the Motions, Magnitudes, and Distances of the heavenly Bodies; together with their Revolutions, Rising, and Setting, the Cause of Eclipses, and the true Time when such Eclipses will happen, *&c.*

Tyr. How many Systems are there?

Phil.

Philo. Eight in all; but as the firſt ſeven, by Reaſon of making the Earth in the Centre, and other Bodies involving or rolling round it with eccentric and ſolid Orbs, and ſuch like ridiculous Stuff, we ſhall take no further Notice of them, than only by ſaying, they are now ſet aſide, and the *Copernican* Syſtem only allowed of, as being conſiſtent to Truth, and agreeable to the common Capacity of Mankind, by undeniable Demonſtrations.

Philo. Why is it called the *Copernican* Syſtem?

Tyro. From *Nicholas Copernicus* of *Thorn* in *Pruſſia*, in the Year 1473; he being the great Reviver or Improver of this Syſtem; though it is aſſerted by the beſt Hiſtorians, that *Pythagoras* taught the ſame (or nearly the ſame) 540 Years before Chriſt, and therefore it is often called the *Pythagorean* Syſtem. *Pythagoras*, it is plain, was not quite clear in reſpect to the true Motions of the Earth, and other Bodies round the Sun; but *Copernicus*, by Application, diſcovered evidently the two Motions of the Earth, *viz.* one round its own Axis in twenty-four Hours (which makes Day and Night) and the other round the Sun in the Space of a Year, which occaſions the various Seaſons.

Tyro. Has no-body ſince that Time made further Improvements in this Syſtem?

Philo. Yes, the unparalleled Sir *Iſaac Newton*, the Glory of *England*, and the Maſter-piece of Nature. This great Man was favoured with more than a natural Genius, and Heaven vouchſafed to convey to us through this Channel many Things unknown to the Antients, and which there is not ſufficient Room here to treat of: But however, he regulated and completed whatever *Copernicus* was ignorant of—He diſcovered the juſt Laws of Gravitation of Matter to Matter, or of one Body to another, by which the Accuracy, Harmony, and Agreement of the Heavenly Bodies are ſeen by one ſimple Principle, and their amazing Revolutions and Velocities round the Sun, as their common Center, eaſily accounted for, and the Power and Wiſdom of the *Great Architect* (in ſome ſmall Meaſure) at the ſame Time is beheld by Man to an aſtoniſhing Pitch of Admiration, in order to humble him, and duly to conſider

conſider the infinite Diſproportion between the Creature and Creator.

SECT. II.

Of the Copernican *Syſtem, or the Doctrine of the Sun and the ſix primary Planets.*

Tyro. Pray, kind *Philo*, give me ſome Account of the Sun, and ſome other of the heavenly Bodies.

Philo. I will, as far as Room will allow of, and firſt we will ſpeak of that huge and glorious Body of Light the Sun.

Tyro. What do you mean by calling it a *huge* Body; it appears to me to be but very ſmall.

Philo. No matter how it may appear to the naked Eye; plain it is, that the Sun is ſo vaſtly large above the Globe of the Earth, that it will hardly bear any Compariſon; it being very little leſs than 1,000,000 (*viz.* a Million) Times larger; for its Diameter is computed to be 822,148 Miles, and its Bulk not leſs than (290,971,000,000,000,000 Miles) 2 hundred and 90 thouſand, 971 Millions of Millions of ſolid Miles.

Tyro. Very ſurprizing, and almoſt incredible!

Philo. It is quite ſo to Perſons who know nothing of the Nature of Angles and Circles, and they naturally think that you are impoſing upon them, and aſſerting Falſities: But however, as Ignorance and Obſtinacy are inſeparable Companions, if at any Time you meet with ſuch as will not give Credit to theſe Things, be not too raſh with them, but reaſon calmly, and let them know that this Diſtance is even as nothing in Compariſon to the Diſtance of the fixed Stars; and therefore there is little Cauſe to wonder at ſuch an Aſſertion; and much leſs, would they truly conſider the infinite Power and Wiſdom of the heavenly Architect.

Tyro. Very true, Sir; but there are many Perſons as well as myſelf, that may be very ready to believe this; but yet would like to know how to prove it, or ſee it demonſtrated.

Philo. No doubt of it; and I am ſenſible that you will allow, that when the Diameter of any Circle or Body is known, the Area and Solidity are eaſily found; and it is well known, that 'tis as eaſy to tell the Diſ-

tanſes

A TABLE of the Six Primary Planets, with their Affections, &c.

	SATURN.	JUPITER	MARS.	EARTH	VENUS.	MERC.
Their Diameter in Engliſh Miles,	67870	81155	4444	7964	7900	2460
Their Circumference,	213112	250908	13960	35020	24823	7704
Their Superficies in ſquare Miles.	14468430000	29688000000	62032000	199250205	196238000	1904804
Their Magnitude in cubic Miles,	1636377000000000	2810423000000000	45966600000	264466789070	258445900000	7793273000
Their mean Diſtance from the Sun in Miles,	77700000	424000000	123000000	81000000	59000000	32000000
The Diameter of their Orbs in Miles,	1554000000	848000000	246000000	162000000	118000000	64000000
The Circumference of their Orbs,	4881891000	2662180000	773686000	508929200	370636000	201024000
Their daily Revolution round their Axis,	— — —	9 h. 56′	1d. oh. 40′	23 h. 56′	23 h. 0′	— —
Their periodical Times,	10759d. 6h. 36′	4433d. 12h. 20′	686d.23h.27′	365d. 6h. 49′	224d. 16h. 49′	87d. 23h.16′
Daily mean Motion in the Ecliptic,	— — 00′	4′ 59″	31′ 27″	59′ 8″	1° 36′ 8″	4° 5′ 32″
Inclination of their Orbits to the Ecliptic,	2° 20. c″	1° 20′ 0″	1° 52′ 0″	— —	3° 24′ 0″	6° 54′ 0″
Proportion of their Bulks,	621350	1064500	170	1000	985	30
Proportion of Light and Heat,	1 $\frac{1}{10}$	31 $\frac{1}{10}$	43	100	200	

[To face Sect. II. of the Copernican Syſtem, Page 302]

tances and Bulks of any Bodies, when we know the different Times of their Motions round different Circles, having one Center; or (which is more natural and eaſy) by comparing the apparent Diameter of any diſtant Object with the real Diameter of the Image thereof, by imaginary Lines drawn from the extreme Parts of the one to the extreme Parts of the other, &c. Do you underſtand this?

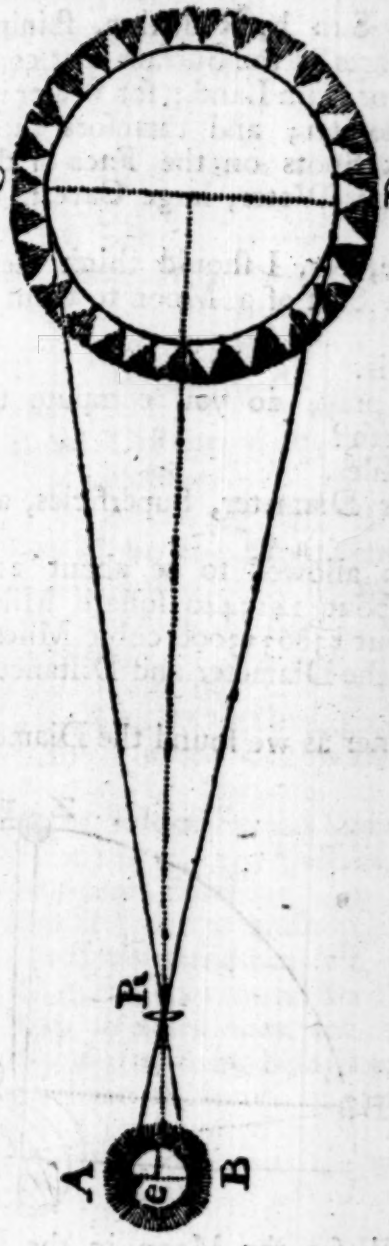
Tyro. I can't ſay I do as yet; and therefore beg if you can, to demonſtrate it by ſome Figure.

Philo. That I will with all my Heart. And I think if you do but mind the Nature and Deſign of the following Figure, and well obſerve the Compariſon of the two Objects, you will ſoon ſee it is not ſo difficult to underſtand as you imagined.——Obſerve then,

1. Take a double Convex Glaſs (or Lens), let there be a ſmall Hole as at R; place this Lens in the Window-ſhutter of a darkened Room; this being done, fix a Sheet of Paper at any proper Diſtance, according to the Size of the Room, (ſuppoſe from 10, 12, or more Feet from the Lens) and you will find two Rays of Light paſſing from the Extremity of the Body of the Sun CD, through the Lens R, making the Lines CRB, and DRA; which will form an Image of the Sun itſelf, whoſe Diameter will be AB, and in Proportion therewith from the Diſtance of the Lens.

2dly, But though this Proportion holds good always, yet the Work will vary according to the Diſtanee of the Lens from the Image; but let us ſuppoſe the focal Diſtance R A=R B to be 12 Feet or 144 Inches, then by carefully meaſuring the Diameter of the Image A B (if the Hole of the Lens be of a proper Size) it will be one Inch 34 Parts, whoſe Semi-Diameter e B or e A, 0.67 Parts.

3dly.



3dy. Then it will be, As R A or R B 144: ½ the Diameter A B, *viz.* e A or e B 0.67 Parts :: Radius to the Sine of the < e R A, or e R B 16′; and therefore the < A R B will be 32′ = to the Diameter of the Image, or the apparent Diameter A B. Therefore,

4thly, The Proportion will be thus, in order to find the Diameter.

As the Diſtance of the Image, *viz.* R A to its Diameter; ſo is the given Diſtance of the Sun's (*viz.* 82136014 Miles) to his Diameter, which in this Caſe will be 764320 Miles; which is leſs than is computed by many thouſand Miles, but notwithſtanding this, it is ſo trifling, that it produces no Error, nor makes any ſenſible Difference in calculating Eclipſes in general.

Tyro. I thank you, dear *Philo*; and now pray give me a little Account of the Moon.

Phil. I will.

SECT. III.

Of the Moon.

Tyro. What do you apprehend the Moon to be?

Phil. The Moon is allowed to be a dark ſpherical Body, like to the Earth in Matter and Form, and bor-

rows her Light from the Sun by Reflexion, ſhining upon that Part, or thoſe Parts of the Surface that conſiſts of Hills, Mountains, or plain Land; for Water itſelf will not admit of Reflexion; and therefore thoſe Parts that look like dark Spots on the Face of the Moon, are, no doubt, either Water, large Caverns or Pits, &c.

Tyro. If this be the Caſe, Sir, I ſhould think then, that our Earth muſt be a Sort of a Moon to them at certain Times.

Phil. Moſt certainly it is.

Tyro. What Diſtance, pray, do you compute the Moon to be from the Earth?

Phil. About 238920 Miles.

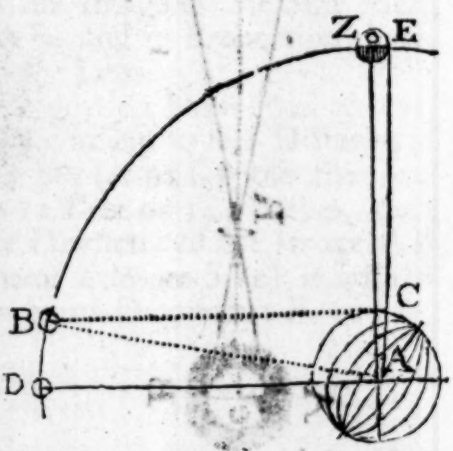
Tyro. Pray what is her Diameter, Superficies, and Magnitude?

Phil. Her Diameter is allowed to be about 2175 Miles, her Superficies about 1415440 ſquare Miles; and her ſolid Content about 5386333000 cubic Miles.

Tyro. How do you find the Diameter and Diſtance of the Moon?

Phil. In the ſame Manner as we found the Diameter of the Sun, *viz.*

1. Let A C be the Earth, D B E Part of the Moon's Orbit, Z the Moon in the Zenith, A D the rational, and C B the ſenſible Horizon, and let the Moon be in the Horizon at B: Now it is evident, that an Eye placed in the Center at A will eſe the Moon in her true Place, in the Line A B; but an Eye on the Surface at C, will ſee the Moon in the Line C B, called her apparent Place; and the Difference of theſe two Places, *viz.* the Arch B D is called the horizontal Parallax = 1° 2′ 10″. Now the Angle at C is a right one, and A C is the Semi-Diameter of the Earth; and



and therefore in the Triangle CBA the Side BC, *viz.* the Diſtance of the Moon, is found by this Proportion.

As the S of the < B 1° 2′ 10″	Log.	8.25741
To CA		0.00000
So is the S of the < CAB 88° : 57 : 50		9.99992
To the Side BC 55.27		1.74251

The Moon then, when in the Eye or Line BC at B, is 55 Semi-Diameters and $\frac{27}{100}$ Parts diſtant from the Point B. Now the Semi-Diameter of the Earth is 3982 Miles. Now $55\frac{27}{100} \times 3982 = 220085\frac{1}{2}$ Miles her neareſt Diſtance CB; by the ſame Rule you may find the Side AB her Diſtance from the Center of the Earth to be $220344\frac{78}{100}$ Miles.

To find her Diameter.

Let Z be the Moon, and o her Center, draw Ao and AE, and oE will be her apparent Semi-Diameter at the Center of the Earth, and the Angle EAo 16′ 52″. Therefore,

As the Sine of the ∠ AEo 89° 43′ 8″		9.99995
To the Side AO = 22.344.78 Miles		5.34261
So is the S of the < EAo 16′ 52″		7.69066
So is the Side or Semi-Diameter Eo 1079.6		3.03327

This × 2 is = $2159\frac{2}{10}$ Miles, the Diameter itſelf, which is very near Truth.

Tyro. I heartily thank you, Sir; but pray, does the Moon move round her own Axis, and round the Earth; as the Earth does round her Axis and round the Sun?

Philo. Yes ſhe does, for ſhe is called the Earth's *Satellite*, or Attendant, being a ſecondary Planet, appointed by the Law of Nature to attend upon the Earth in its annual Courſe round the Sun.

Tyro. But you ſaid juſt now, that the Moon moves round the Earth, as well as round her own Axis; pray in what Time does ſhe perform this?

Philo. Both in the ſame Space of Time; for ſhe revolves about her Axis in 27 Days, 7 Hours, 43 Minutes; and alſo round the Earth in the ſame Time.

Tyro. This is a Myſtery to me at preſent, but I ſuppoſe there is no Certainty of what you aſſert.

Philo. It is very evident it cannot be otherwiſe.

Tyro.

Tyro. Why ſo?

Phil. Becauſe we ſee the ſame Face, Figure, or Side of the Moon at the ſame Times, or Spaces of Times from one New Moon to another; which never could happen, unleſs by her periodical Motion (*viz.* in her whole Revolution) ſhe turned ſo much of her Body from the Earth as is turned towards the Earth by her daily Motion round her own Axis.

Tyro. I apprehend it now very clearly: But pray, Sir, let me aſk what the Form of the Moon's Orbit is?

Philo. Her Orbit is eliptical; but ſo irregular is the Motion, that ſhe is by this Means perpetually changing both her Place and Figure.

Tyro. From what does this proceed?

Philo. From the Excentricity of her Orb, and the Obliquity, Crookedneſs, or Irregularity of her Axis in her diurnal Motion in the Ecliptic.

Tyro. Why does not the Moon move regularly in the Ecliptic then?

Philo. No, for if ſhe did you would find an Eclipſe of the Sun every Conjunction, or every New Moon.

Tyro. Then I perceive that ſhe does not move directly in the Plane of the Ecliptic.

Philo. You are right; for ſhe makes an Angle therewith of about 5° 17′ 20″, by two Interſections, in 2 Points exactly oppoſite to each other, called *Nodes:* This (☊) is called the Dragon's Head, or aſcending Node, it being that Point of the Ecliptic which the Moon interſects when ſhe paſſes out of South into North Latitude; and this (☋) is called the Dragon's Tail, being the deſcending Node, or Point that ſhe interſects paſſing from North into South Latitude.

Tyro. Pray have theſe Nodes any Motion?

Philo. Yes, they have a Diurnal Motion of about 3′ 11″, and that contrary to the Order of the Signs themſelves; but more of this when we come to ſpeak of Eclipſes.

Tyro. I am obliged to you, Sir; but pray what is the Reaſon we ſee the Moon riſe or ſet about an Hour later every Night than it did the Night before; is this owing to any particular Motion?

Philo. Yes, from a diurnal Motion of about 13° 10′, from Weſt to Eaſt round her Orbit, which, together with the Motion of the Earth round her Orbit, makes

very near an Hour's Difference of riſing and ſetting one Night with another, according to vulgar Computation, but it is not ſo every Night, being ſometimes as much again as at others, according to the different Times of the Year, and the different Parts of the Ecliptic, that the Earth and Moon may then happen to be in: which different Poſitions will of Courſe make different Aſpects in both at certain Times; as is evident from the different Aſpect of the Moon towards the Autumn, vulgarly called the Harveſt Moon, which looks larger than at other Times, and does not ſet the next Night after full, but riſes about the ſame Time for ſeveral Nights together.

Tyro. I am glad you mentioned this, becauſe I know many Perſons as well as myſelf are ignorant of the Reaſon why it appears ſo at this Time. Be ſo kind therefore to give me ſome further Account of it.

Philo. You will ſoon ſee the Reaſon, if you will but attend to the following Obſervations.

1. In all oblique Spheres, every great Circle interſecting the Horizon muſt in the Revolution cut or interſect the Horizon in different Parts and at different Angles.

2. When the Sign Libra riſes in the Eaſt Point, the Ecliptic then makes a much greater Angle with the Horizon, than when Aries riſes orient or in the Eaſt, and when Capricorn riſes orient, then the Ecliptic cuts the Horizon in an Angle, which is a Mean between the other two.

3. Hence it is, that when the Moon is at the full in, or about Libra, ſhe will then be depreſſed the loweſt under the Horizon, and in or near Aries leaſt of all; conſequently therefore the Difference of her riſing at, or towards the autumnal Equinox will be leſs for ſeveral Nights together, than towards the Vernal Equinox.

4. When the Nodes ſhall happen to be in or near the Equinoxes, a full Moon then that happens in the Beginning of Libra, will not riſe the next Night for upwards of one Hour and a Quarter after the Time ſhe roſe the Night before, and ſo on nearly for ſeveral Nights together. But,

5. Should the Moon at this Time be in Perigium, (*viz.* or at her neareſt Diſtance from us) then the Intervals

tervals of her riſing will be greater in Spring than in Autumn.

6. Thus it is plain the Autumnal or Harveſt Moon (*viz.* the full Moon before the 21ſt of *September*) riſes with leſs Intervals, or with much leſs Difference Night after Night, than the vernal full Moon, or that which happens before or neareſt the 21ſt of *March*, as may be ſeen in a common Almanack of any Date, but more particularly by the following Table.

A TABLE *of the nightly Difference of the riſing of the Vernal and Autumnal Full Moon, for the Year* 1760, &c.

Full Moon, *March* 1ſt.				Full Moon *Aug.* 26.		
Day	riſes	Difference		Day	riſes	Difference
2	6h. 8′	h. m.		27	7. 53	h. m.
3	7. 19.	1. 11		28	8. 11	0. 18
4	8. 30.	1. 11	&c.	29	8. 28	0. 17
5	9. 38.	1. 8		30	8. 46	0. 18
6	10. 47.	1. 9		31	9. 8	0. 22

Tyro. I am highly obliged to you, kind *Philomathes*, and am now quite ſatisfied it is ſo; but now I don't know the Reaſon why it riſes ſooner at one Time than at another.

Philo. You have been told Part of the Reaſon already; but however the chief Reaſon of the Difference is, that at one Time the Moon cuts the Horizon nearer to right Angles at riſing than at the other Time, and conſequently is longer before ſhe appears above the Horizon.

Tyro. I humbly thank you, Sir, and am now very clear in what you have ſhewn me.

Philo. Then I am ready to anſwer you in what you ſhall farther aſk.

Tyro. I ſhould be glad then, Sir, to know ſomething concerning *New* and *Full* Moon, the Reaſon of her appearing in ſuch various Aſpects, and alſo to be inſtructed a little concerning Eclipſes, of which I have very little Notion at preſent.

Philo. Any Thing, my dear *Tyro*, that I can ſerve you in, you are welcome to; but you muſt expect but a ſmall Hint of theſe Things; which therefore requires your greater Attention and Application. However, my Opinion is, that you ought firſt to underſtand the

Meaning

Meaning of ſeveral Words and Phraſes previous to the better underſtanding of what we ſhall hereafter treat upon.

Tyro. Sir, you are very kind, and I am ſenſible of the Neceſſity of what you ſay.

Philo. Then we will proceed to

SECT. IV.

An Explanation of ſeveral Things neceſſary to the Knowledge of Aſtronomy, &c.

Tyro. What do you mean by a periodical Month?

Philo. The Time that the Moon moves from, or to her Courſe from any Point of the Zodiack to the ſame Point, which is about 27 Days, 7 Hours, 43 Minutes,

Tyro. What is a Synodical Month?

Philo. Exactly the twelfth Part of a Year, or the Time the Sun is paſſing through one Sign of the Zodiack, being about 30 Days, 10 Hours, 30 Minutes, which is alſo called an Aſtronomical Month.

Tyro. What is the Difference between this and a Lunar Synodical Month?

Philo. A Lunar Synodical Month is the Time or Space between two Conjunctions with the Sun, or from one New Moon to another, being about 29 Days, 12 Hours, 44 Minutes *.

Tyro. What do you mean by an Illuminative Month?

Philo. That Space of Time from the Beginning of the New Moon's ſhining till ſhe diſappears again, being about 26½ Days.

Tyro. What is a Lunation?

Philo. The ſame as a Lunar Synodical Month.

Tyro. What is a Lunar Year?

Philo. It contains 12 Lunations or Synodical Months, *viz.* about 354 Days, 8 Hours, 48 Minutes, 38 Sec. *viz.* 29 Days, 12 h. 44′ 3″ 11‴ × 12, nearly.

* Note, This is a mean Synodical Month; for you muſt obſerve, every Synodical Month is not quite equal; for about the Summer Solſtice the Sun moves much ſlower than in Winter; and the Synodical Month is then but 29 Days, 6 Hours, 42 Minutes, but in Winter it is 29 Days, 19 Hours, 37 Minutes.

Tyro.

Tyro. What do you mean by a Tropical or natural Year?

Philo. It is that Space of Time in which the Sun being in any Point of the Zodiac departing therefrom, returns to it again: or in other Words, it is that Space of Time the Sun takes to finiſh his Courſe through the Zodiac, which is nearly 365 Days, 5 Hours, 48 Minutes, 15 Seconds.

Tyro. Then I perceive there is almoſt 11 Days Difference between the Lunar and the Tropical Year.

Philo. Very true, and this is what is called the Epact itſelf, and by the Help of this the Moon's Age is found at any Time.

Tyro. Now you have mentioned the Epact, I wiſh you would explain this farther, and alſo ſhew me how to find the Golden Number, &c.

Philo. That I will do with all my Heart.

SECT. V.

To find the Prime or Golden Number, the Epact, Cycle of the Sun, Dominical Letter, &c.

1. *Of the* PRIME.

Tyro. What do you mean by the Prime or Golden Number?

Philo. The Prime or Golden Number is the Cycle of the Moon, *viz.* a Circle, Revolution or Period of 19 Years; at the End of which the Changes of the Moon will fall upon the ſame Day (but upwards of an Hour ſooner) and ſhe makes the ſame Aſpect with the Sun, *&c.* as ſhe did 19 Years before: It is ſaid that it took its Name of Golden Number from *Julius Cæſar*, who cauſed it to be inſerted in the Calendar in Letters of Gold.

Tyro. What is the Uſe of the Golden Number?

Philo. To find the Age and Changes of the Moon, &c.

Tyro. How is the Golden Number found?

Philo. Add 1 to the Year of our Lord, or Date of the Year, then divide by 19, and the Remainder at laſt is the Golden Number. N. B. If nothing remains after the Diviſion, then 19 itſelf is the Golden Number.

EX-

EXAMPLE.

I demand the Golden Numbers for the Years 1748, 1760, and 1785.

1748	1760	1785
1 add	1 add	1 add
19)1749(92	19)1761(92	19)1786(94
171	171	171
39	51	76
38	38	76
G. Num. 1	G. Num. 13	0 remains,
		Therefore 19 is G. N.

2. *Of the* EPACT *.

Tyr. What is the Epact?

Phil. The Epact is the Exceſs or Number of Days that the Solar exceeds the Lunar Year; the Solar being vulgarly accounted 365, and the Lunar 354 Days, the Difference is 11, which is called the Epact; thus you ſee one Year is 11 Days, 2 Years 22 Days, 3 Years 33 Days, *&c.* but 30 being accounted a whole Lunation, you are to ſubtract 30, when it is above that Number, and the Remainder is the Epact.

Tyr. But pray give me a general Rule with an Example or two.

Phil. 1. To find the Epact according to the Julian or Old Stile.

Rule. Divide the *Golden Number* by 3; if nothing remains the Epact is the ſame as the Golden Number, but if 1 remains, add 10; if 2 add 20, and that will be the Epact.

2. To find the *Epact* according to the Gregorian or New Style.

Rule. From the Golden Number take 1; then divide the Remainder by 3, and if nothing remains, then the Epact will be the ſame as the Dividend, *viz.* 1 leſs than the Golden Number itſelf; but if 1 remains, add 10 to the Dividend; if 2 remains, then add 20 to the

* See the Rule, Page 321.

Dividend, and the Sum ſhall be the Epact for N. S. Thus in the laſt Section, the Golden Number for 1760 is 13; and for 1785, 19. Then,

G. Num. 1760		G. N. 1785	
	13		19
Subtract	1	Subtract	1
	3)12(4		3)18(
	12		18
	12		18
to remains,		o Epact 18.	

therefore the Epact is 12.

Again, 1753, G. Num. 6
Subtract 1

3) 5(1
3

2 remains, therefore add 20 to 5 the Dividend, it gives 25, the Epact.

Here follows a TABLE *of* 19 *Epacts for the* Julian *and* Gregorian *Account, with their Golden Numbers:*

G.N.	Julian Ep. O.S.	Gregorian EP. N.S.	G.N.	Julian Ep. O.S.	Gregorian Ep. N.S.
1	11	29	11	1	20
2	22	11	12	12	1
3	3	22	13	23	12
4	14	3	14	4	23
5	25	14	15	15	4
6	6	25	16	26	15
7	17	6	17	7	26
8	28	17	18	18	7
9	9	28	19	29	18
10	20	9			

3. *Of the* CYCLE *of the Sun.*

Tyr. I remember you told me the *Cycle* of the Moon is a Revolution of 19 Years; pray what is the *Cycle* of the Sun?

Phil. This is a Revolution of 28 Years, at the End of which the Dominical or *Sunday* Letters A B C D E F and G (which are generally placed againſt the *Sundays* in common Almanacks) return again to the ſame Order they were in, 28 Years before, and the 29th Year begins a new Cycle.

Tyro. I underſtand you in Part, but why do you uſe juſt 7 Letters, and never more or leſs?

Phil. Becauſe there are 7 Leap Years included in this Cycle; for every 4th Year you know is Leap Year, and $7 \times 4 = 28$ the Cycle.

Tyr. I am obliged to you; but how is the Cycle for any Year paſt, or to come, found?

Phil. By the following Rule.

Add 9 to the given Year, and divide by 28, the Remainder is the Cycle.

EXAMPLE.

For 1760	For 1795
9	9
28)1769(63	28)1804(64
168	168
89	124
84	112
5 Cycle	12 Cycle

Tyr. I underſtand it plainly; but pray will this Rule hold good for any Time to come?

Phil. No longer than till the Year 1799; for every centeſimal Year being a Leap Year, it is omitted, and therefore another certain Number muſt be added to every Year of the next, or 19th Century; and in the 20th Century another certain Number.

Tyr. By what Rule then am I to find the Cycle of the Sun for the next Century.

Philo. As follows.

To find the Cycle of the Sun the next Century.

Add 25 to the Date of the Year (as you added 9 before) then divide by 28, and the Remainder will be the Cycle of the Sun for that Year; and this Rule ſtands good from 1800 to 1900.

EXAMPLE.

For 1860	For 1879
25	25
28)1885(67	28)1904(68
168	168
205	224
196	224
9 Cycle	remains 0 therefore the Cycle is 28.

Tyr. But how is the Cycle found in the 20th Century, *viz.* from 1900 to 2000.

Phil. As follows.

Rule. To the Number you added in the 19th Century (*viz.* 25) add 16 more, and from that Sum take 28, and the Remainder will be the Number to be added to the Date of the Year from 1900 to 2000. Thus,

$25 + 16 = 41 - 28 = 13$, Number to be added in the 19th Century, *&c.*

Example. What is the Cycle of the Sun for 1960?

1960
13

28)1973(70
196

13 Cycle.

Tyro. I underſtand the Rule very well; but will not this Method of finding the Dominical Letter after this Century, be changed as well as for finding the Cycle.

Phil. Yes, certainly; but that will be better explained when we come to treat of the Dominical Letter; in the mean time you will do well to remember that the Years

Years 1800, 1900, 2000, &c. being Leap Years, ſhould have 2 Letters, according to the Old Style or Julian Account; but the Leap Year will be omitted every Century, and the Method or Rule of finding the Dominical Letter for any Time to come ſhall be ſhewn under that Head.

4. *Of the* DOMINICAL LETTER.

Tyr. What do you mean by the Dominical Letter?

Phil. The Dominical Letter is ſo called by being the Lordly Letter, or that which is placed in every common Almanack againſt the Lord's-Day or *Sunday*.

Tyr. But is this *Sunday*, or Dominical Letter, always the ſame?

Phil. No; there are 7 Dominical Letters anſwering the 7 Days of the Week, viz. A B C D E F and G; and theſe Letters alſo are uſed for every Month of the Year; A being ſet for *January*, B for *February*, C for *March*, &c. till you come to G; and then you begin with A again.

Tyr. But pray, Sir, how am I to know what Letter is to be placed or put down for any Year to come in its due Order?

Phil. That I will ſhew you by and by at large; but I think it will be neceſſary firſt, to give you ſome further Account of the Rotation, and Retrogation of theſe Letters, and the more ſo, becauſe, as we keep our Reckoning now in *England* by the Gregorian Account, or New Style, the Rule for finding the Dominical Letter, according to the Julian Account or Old Style, will not do for any Year ſince 1752, for the Difference being 11 Days, there are 2 different Rules to find the Dominical Letter for the ſame Year, according to the Style given, as you will ſee hereafter by an Example in each.

Tyr. What is the Occaſion of the Variation of theſe Alphabetical Letters every Year?

Phil. You will ſee the Reaſon, if you obſerve; for the common computed Year being 365 Days, and 7 Days make a Week, it is evident that dividing 365 by 7, the Quotient is 52 Weeks and 1 Day over; this 1 Day will conſequently be the laſt Day of the Month

December, which ſhould be the Letter A, but this is uſed for *January*, as we ſaid before.

2. Now let us ſuppoſe the Year to conſiſt only of 364 Days, then there would be an even Number of 52 Weeks; all the Years would begin on the ſame Day of the Week, and each Month the ſame Day of the Week; but being 365 Days, the Year ends with the ſame Day it begins with; ſo in every common Year, ſuppoſe the firſt Day of *January* to fall upon a *Sunday*, the firſt Day of *January* the next Year will fall on a *Monday*, and *Sunday* will be the 7th Day of *January* or Letter G, and the next Year will begin on *Tueſday*, and the *Sunday* upon the 6th Day; therefore, the Dominical Letter will be F, *&c.*

3. But every fourth Year is called Leap Year, and conſiſts of 366, and therefore the Order of the Dominical Letter will be interrupted, and will not return again till the End of the whole Cycle, viz. 28 Years $= 4 \times 7$, which ſhews there are 7 Leap Years in the Cycle. Therefore,

4. If in a Leap Year the 1ſt of *January* ſhould fall on a *Sunday*, and the Dominical Letter ſhould be A, then the 24th of *February* will fall on a *Friday*, and the 25th on *Saturday*, and the Letter uſed for both Days will be F; and the next Day being *Sunday* will have the Letter G; ſo that Leap Year, you ſee, will have 2 Letters; one, or that firſt found by the Rule itſelf, ſerves from the 25th Day of *February* to the End of the Year; and the other from the 1ſt of *January* to the 24th of *February*.

Tyr. How do you find the Dominical Letter in general?

Phil. By this following Rule.

Add the $\frac{1}{4}$ Part of the Year to the given Year itſelf; divide that Sum by 7, and the Remainer is the Figure, which repreſents or ſhews the Golden Number according to the Order, *viz.*

1 is A; 2, B; 3, C; 4, D; 5, E; 6, F, and 7 is G.

N. B. If nothing remains after dividing by 7, then 7 or G is the Dominical Letter.

For

For			For		
4)1760			4)1785		
440 is ¼ add			446 add		
7)2200(314			7)2231(318		
21			21		
10	7		13	7	
7	2		7	5	
30	5	E, the D. Let.	61	2	or B
28			56		
remains 2			remains 5		

Then take this Remainder 2 from 7, there remains 5 as above, which anſwers to E the Dominical Letter. But this Year, 1760, being a Leap Year, has 2 Dominical Letters, and therefore ought to have 2 Letters, as was obſerved before.

Tyr. But how am I to know theſe two Letters for a Certainty?

Phil. Having found the Letters according to the Rule; *that* will be the *Dominical Letter*, from the 24th of *February* to the 31ſt of *December*, now called the End of the Year) and the other Letter from *January* to the 24th of *February*, will be always the next Letter in Order of the Alphabet: Thus in 1760, the Dominical Letter is E, ſerving from *February* to *January*; then from *January* to *February* place F, ſo will F E be the Dominical Letters for 1760.

Tyr. Then I perceive the Letters in Leap Year, as well as in other Years, ſometimes move retrograde or backwards.

Phil. You are right, for 1776 will be a Leap Year, and you will find the Dominical Letter A, to be placed from the 24th of *February* to the End of *December*; but B is the next in Order, therefore B is from *January* to the 24th of *February*, and the 2 Dominical Letters for 1766 are B A. Do you underſtand me now?

Tyr. Yes, quite well; but will this Rule hold good after this Century?

Phil. No; for the Years 1800, 1900, *&c.* are Leap

Years, and therefore, according to the Julian Account ſhould have two Dominical Letters, but after this Century will have but one; becauſe every centeſimal Leap Year will be omitted, and the Rule altered, as it was for finding the Cycle.

Tyr. Pray give me the Rule, and an Example.

Phil. I will.

A Rule for finding the Dominical Letter *after the Year* 1800.

I demand the Dominical Letter for 1845. Cut off 2 Figures thus, 18 | 45, divide the firſt 2, *viz.* 18, by 4 (regarding no Remainder) it makes 4, from which take 1=3, which taken from the original Number 18 leaves 15; this Number taken from 21, (*viz.* the neareſt Number of Sevens, that are neareſt the Number 18), leaves 6 the new Number to be added to the given Year, beſides its 4th; then divide by 7, as in the old Rule, and the Remainder ſhall be the Figure anſwering the Dominical Letter as before.

4)1845
461 the 4th } add
6 new Number }

7)2312(330
21
21
21
2 remains.

7
2 remains.
5 or E the Dom. Letter.

Do you underſtand this?

Tyr. Yes, very well; but if you had not demonſtrated the Rule itſelf, I believe I ſhould not have eaſily underſtood it.

Phil. Then I will now give you a Table of Cycles and Dominical Letters for this Century.

5. *A* TABLE *of the* Cycles *of the* Sun *and* Dominical Letters, *till the Year* 1800, *according to the Gregorian Account, or New Style.*

1. Cycles of the Sun till 1800 N. S.

Cycles	Letrs.	Cycles	Letrs.	Cycles	Letrs.	Cycles	Letrs
1	DC	8	B	15	G	22	E
2	B	9	AG	16	F	23	D
3	A	10	F	17	ED	24	C
4	G	11	E	18	C	25	BA
5	FE	12	D	19	B	26	C
6	D	13	CB	20	A	27	F
7	C	14	A	21	GF	28	E

To find the Gregorian Epact *for ever.*

Rule. Divide the Centuries of any Chriſtian Æra, by 4, (rejecting the ſubſequent or odd Number) multiply the Remainder by 17; then to this Product add the Quotient, multiplied firſt by 43; to which add 86, and divide this laſt Sum by 25; then multiply the Golden Number by 11, from which ſubtract the laſt Quotient, and rejecting the Number 30 as often as you can, the Remainder will be the Epact. See Page 313.

SECT. VI.

The Uſe of the foregoing Tables, &c. *with ſome practical Exerciſes concerning the Change of the Moon, High-Water, at any Place,* &c. *and the Method of finding them.*

1. *To tell the Moon's Age at any Time.*

RULE.

Add to the Epact for the given Year as follows, *viz.* for *January* (0), for *February* 2, for *March* 1, *April* 2, *May* 3, *June* 4, *July* 5, *Auguſt* 6, *September* 8, *October* 8, *November* 10, and *December* 10, and to this Sum add alſo the Day of the Month, if the Sum of theſe 3 Numbers are under 30, it gives the Moon's Age, if above 30, then ſubtract 30, and the Remainder is the Moon's Age, and if juſt 30, it is New Moon ſome Time on that Day.

EXAMPLE 1.

I would know the Moon's Age, *June* 20, 1757.

Epact 9 for 1757
Add 4 for the Month *June*
20 the given Day

33
30 ſubtracted

3 the Moon's Age.

EXAMPLE 2.

How old, or what is the Age of the Moon, *December* 11, 1761?

Epact 23 for 1761
10 for the Month
11 the Day given

44
Subtracted 30

14 Moon's Age, which is the Day or nearly ſo that ſhe is at the full.

2. *The Moon's Age given; to tell how many Days it will be to the Change or next New Moon.*

RULE.

Obſerve how many Days the Month conſiſts of in which the preceding New Moon happened, and from the Number of Days contained in that Month ſubtract the Moon's Age, and the Remainder leſs 1 is the Number of Days to next New Moon.

EXAMPLE.

I find by the laſt Example, that on *October* 4, 1760, the Moon was 24 Days old, conſequently this new Moon happened in *September*; therefore,

September has 30 Days
October 4 ☽'s Age 24 Days

6—1=5 Days to the next New Moon, *viz.* the 9th of *October*. *Tyr.*

Tyr. I underſtand you well.

Phil. Then we proceed,

3. *To tell the Time to full Moon.*

RULE.

Add 15 to the Days of Change; if the Sum is under 30, it gives the Number of Days to Full Moon; but if it exceeds 30, the Overplus gives the Number of Days.

EXAMPLE.

I find by the laſt Example, that on the 4th of *October* the Days to change, or to the next New Moon, is 5; therefore $5+15=20$; ſo that on the 20th of *October* the Moon will be at the Full. Again, *June* the 20th, 1760, I find the Change or New Moon 22 Days, then $22+15=37-30=7$, ſo that on the 27th, it will be Full Moon.

4. *To tell the Time of the Moon's Southing.*

Rule. Multiply her Age by 4, and divide her Product by 5, and the Quotient will be the Hour, and the Remainder the fractional Parts of another Hour or the Minutes.

I demand what Time the Moon will be full South on the 21ſt of *April* 1761.

I find her Age to be ſix Days, therefore

6 Days,

4

5)24

4 $\frac{4}{5}$ Anſ. or 48 Minutes

That is 48 Minutes paſt 4 in the Afternoon. Do you underſtand it?

Tyr. Yes, very well; and pray what have you further to obſerve?

Phil. Several Things more which are very uſeful. As,

5. *The Time of the Moon's Southing being given, to tell the Time of High-Water at* London Bridge.

Rule. Add 3 to the Time of her Southing, and you

have very near the Time of High-Water at *London Bridge*, rejecting 12, if it be above that Number.

Thus, by the foregoing Example, I find the Moon full South 48 Minutes paſt 4 in the Afternoon on *April* 27, 1761; to which if I add 3, it will be 48 Minutes paſt 7 in the Evening, the Time (very nearly) of High-Water at *London-Bridge*.

Tyr. I underſtand you well; but why is the Number 3 in particular to be added, will no other Number do?

Phil. Not for the Port of *London*, but for other Ports or Places you muſt add different Numbers.

Tyr. I am now quite at a Loſs, and ſhould be very glad that you would ſhew me the Reaſon of High-Water at a few noted Places, and how I may always find it.

Phil. That I will very readily do.

6. *Shews the Reaſon of High-Water at* London-Bridge, *and the Method of finding it in any other Port or Places.*

Tyr. You told me that if I add 3 to the Moon's Southing, it tells me the Time of High-water at *London-Bridge*; but for what Reaſon, pray?

Phil. The full Tide in any Place depends upon the Point of the Compaſs the Moon happens to be upon; and the Diſtance in Degrees of ſuch Point or Points, that are diſtant from the North or South Pole, converted into Time, gives the Hours and Minutes to be added to her Southing.

Tyr. But how am I to know the Method of reducing theſe Degrees into Time?

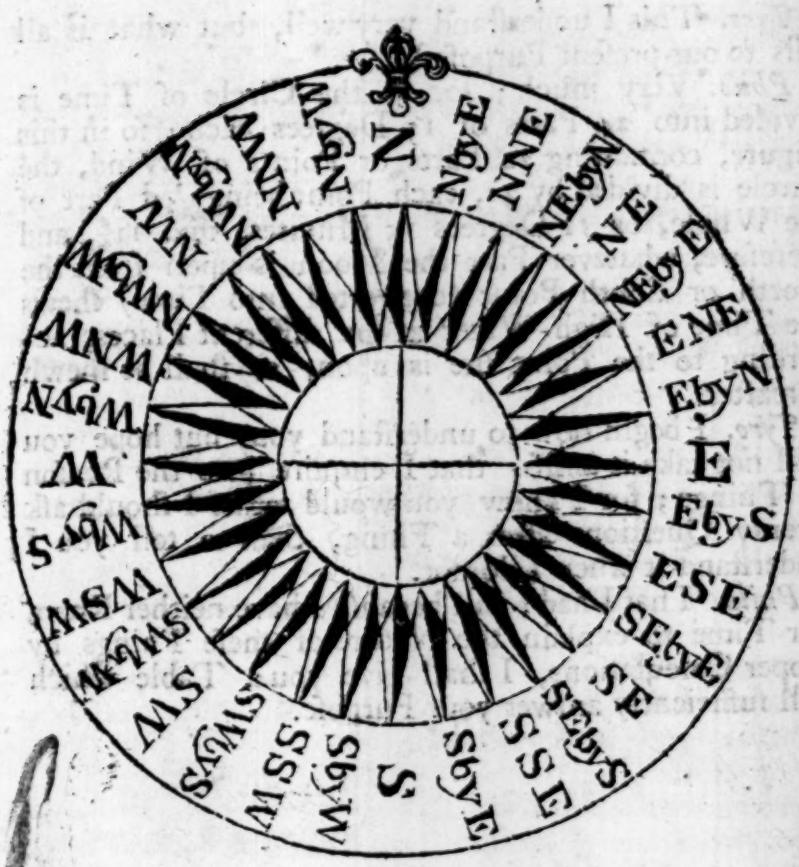
Phil. Very eaſily; for I take it for granted, you know how many Points there are in the Compaſs, and alſo which are oppoſite one to the other.

Tyr. Indeed I do not.

Phil. Then it is high Time you ſhould, and you may ſoon do it by looking over the following Figure, called

7. *The*

7. *The Mariner's Compaſs.*



1. This Figure ought to be learnt by Heart, beginning at the North Point, and proceeding to the Eaſt, and ſo quite round.

2. You are alſo to learn what the Mariners call *boxing* the Compaſs, *viz.* to know immediately what Points are oppoſite; S. E. is oppoſite N. W. and N. W. by N. is oppoſite S. E. by S. *&c.*

Tyr. I underſtand you well; but what is this to do with telling me High-Water at different Places.

Phil. Very much, it depends upon the Compaſs in a great Meaſure.

Tyr. Why ſo?

Phil. You know every Circle contains 360 Degrees,

and 15 Degrees contain 1 Hour in Time, for $15 \times 24 = 360$.

Tyro. This I underſtand very well, but what is all this to our preſent Purpoſe?

Philo. Very much; for as the Circle of Time is divided into 24 Parts of 15 Degrees each; ſo in this Figure, containing 32 Parts or Points of Wind, the Circle is divided by 32, each Point being $\frac{1}{32}$d Part of the Whole, or 11 Degrees 15 Minutes, *viz.* $11\frac{1}{4}$, and therefore, whatever Part the Moon is upon from the North or South Point (converted into Time) ſhews the Time of High-Water at the different Places, according to the Point ſhe is upon, as ſhall be ſhewn hereafter.

Tyro. I begin now to underſtand you, but hope you will not take it amiſs, that I enquire into the Reaſon of Things; for I know you would rather I ſhould aſk twenty Queſtions after a Thing, than to tell you I underſtand it when I do not.

Philo. That I had; but becauſe I have neither Room nor Time to explain the Nature of theſe Things by proper Calculations, I ſhall give you a Table which will ſufficiently anſwer your Purpoſe.

TABLE

TABLE I.

8. *An alphabetical Liſt of ſeveral of the moſt noted Places, on or near the Coaſts of* Great-Britain, France, Holland, &c. *ſhewing what Point of the Compaſs the Moon is upon, to make High-Water, as alſo the Time of High-Water at ſuch Places.*

Places.	Points.		
A			
Aldborough	SE by S & NW by N	9	45
Amſterdam	NE & SW	3	
Antwerp	E & W	6	
B			
Beachy and Blacktail	N & S	12	
Berwick	NE by N & SW by S	2	15
Breſt	NE by E & SW by W	3	45
Briſtol Key	E by S & W by N	6	45
Bridgewater	ESE & W NW	7	30
C			
Cork, Calais, C. Clear	ENE & WSW	4	30
Caſkets	SE by S & NW by N	9	45
Cowes	SSE & NNW	10	30
D			
Dartmouth	E & W	6	
Dover Pier & off Dunkirk	N & S	12	
Dover, Diepe and Downs	SSE & NNW	10	3
Dublin	SE by E & NW by W	8	15
Dunbar	SE & NW	9	
E			
Embden	N & S	12	
F			
Flanders Coaſt	N & S	12	
Fluſhing	N by E & S by W		45
Flamborough	ENE & WSW	4	30
Foulneſs and near Falmouth	E by S & W by N	6	45
Foreland South	SSE & NNW	10	30
Foreland North	S by E & N by W	11	15
G			
Gibraltar Road	N & S	12	

Places.	Points.		
Gravesend	NNE & SSW	1	30
Groin	NE & SW	3	
H			
Harwich Within	S by E & N by W	11	15
St Helens	SSE & NNW	10	30
Hull and Hamburgh	E & W	6	
I J			
Irish Havens on the South	E by N & W by S	5	15
Jutland	N & S	12	
L			
Leith	N & S	12	
Leostaff	SW by S & NW by N	9	45
Lizard	ESE & WNW	7	30
London	NE & SW	3	
Lynn	E by S & W by N	6	45
M			
Malden	N by E & S by W		45
Margate	S by E & N by W	11	15
Milford	E by N & W by S	5	15
N			
Nantz	NE & SW	3	
Naze	S by E and N by W	11	15
Needles and Wight Island	SE by E & NW by W	8	15
Newcastle	E by N & W by S	5	15
Newport	N & S	12	
Nore at the West End	N by E & S by W		45
P			
Plymouth	E by N & W by S	5	15
Portsmouth	N & S	12	
Portugal Coast	NE by E & SW by W	3	45
Portland Race	SE & NW	9	
Q			
Quin, or Queenborough	N & S	12	
R			
Rochester	N by E & S by W		45
Rotterdam	NE & SW	3	
Ramsey	E by N & W by S	5	15
S			
Scarborough	NE by E & SW by W	3	45

Places.	Points.		
Severn at the Mouth			
Southampton at the Spits and along the Swin	N & S	12	
T			
Tinmouth and Tees	NE & SW	3	
Texel Cliffs	ENE & WSW	4	30
Torbay	E & W	6	
U			
Uſhant Bay within	ENE & WSW	4	30
Uſhant without	E & W	6	
W			
Winchelſea	N by E & S by W		45
Wells, Weymouth, and Waterford	E & W	6	
Y			
Yarmouth	SE by E & NW by W	8	15
Yarmouth Road	SSE & NNW	10	30
Z			
Zealand Coaſt	NNE & SSW	1	30

9. *An Explanation of the foregoing Table.*

Tyro. Be ſo kind, Sir, as to give me an Example or two of the proper Uſe of this Table.

Philo. Suppoſe I wanted to know the Time of High-Water at *London*, at the Full and Change of the Moon, and what Point the Moon is upon at the Time of High-Water.

I look in the Table for *London*, and find againſt it NE and SW, which is 4 Points of the Compaſs from the North or South Points; that is 4 Times 11 $\frac{1}{4}$, which is 45 Degrees; now every 15 Degrees is 1 Hour, therefore 45 muſt be 3 Hours from 12 o'Clock: But at *Torbay* I find the Hour to be 6; therefore the Moon at that Time is either on the Eaſt or Weſt Point of the Compaſs.

Tyro. I underſtand this quite well; but how am I to find the Time of High-Water at any Place.

Philo. By either of the following Tables.

TABLE

TABLE II.

Shews the Time of the Moon's Southing on every Day of her Age.

Moon's Age.		Southing. Hours	Min.
1	16	0	48
2	17	1	36
3	18	2	24
4	19	3	12
5	20	4	
6	21	4	48
7	22	5	36
8	23	6	24
9	24	7	12
10	25	8	
11	26	8	48
12	27	9	36
13	28	10	24
14	29	11	12
15	30	12	

TABLE III.

Time of Full Sea at Full and Change given (by Table I.) to tell it at any Time or Place

Moon's Age.		Time to be added.	
1	16	0	43
2	17	1	20
3	18	1	52
4	19	2	22
5	20	2	52
6	21	3	26
7	22	4	7
8	23	4	55
9	24	5	50
10	25	6	53
11	26	7	59
12	27	9	4
13	28	10	8
14	29	11	5
15	30	00	00

The Use of Table II.

Example. Suppose the Moon to be 10 Days old; I demand the Time of her Southing?

I look into the Table for 10, her Age; and against it in the second Column I find 8, therefore I conclude that 8 Hours past Noon, *viz.* at 8 at Night, the Moon will be full South at 10 Days old.

N. B. You must note, that in the first Column you find 25 against 10; therefore as 8 in the second Column stands against 25, as well as 10, the Moon will be full South at 8 when she is 25 Days old, as well as when she is 10 Days old; but with this Difference, that at 25 Days old it will be 8 o'Clock in the Morning instead of the Evening.

10. *The*

10. *The Moon's Age being given, to tell the Time of High-Water on any Day at any Place.*

Example. Suppoſe the Moon 10 Days old (as in the laſt) I demand the Time of High-Water at *London-Bridge*, *Yarmouth* and *Torbay*.

1. I find by Table 2d, that the Moon is full South at 8 at Night, when ſhe is 10 Days old (by the laſt Example) and turning to Table I. I find right againſt *London* 3 Hours; this being added to her Southing, (*viz.* 8) makes 11; the Hour of the Night of High-Water at *London-Bridge*.

2. For *Yarmouth*. Look in Table I. as before, and right againſt it I find 8 Hours 15 Minutes, which I add to 8, the Moon's Southing (as before) and it gives 16 Hours 15 Minutes. This being above 12, I ſubtract 12 from it, and find 4 Hours 15 Minutes remain; therefore it is 4 Hours 15 Minutes paſt Midnight, *viz.* 15 Minutes paſt 4 in the Morning.

For *Torbay*. I find 6 in the firſt Table, therefore I add 6 to the Moon's Southing, *viz.* 8, which gives 14, which being 2 above 12, ſhews it is High-Water at *Torbay* at 2 in the Morning, when the Moon is 10 Days old. And thus for any other Places.

Tyro. I underſtand you quite well; but what is the Uſe of Table III?

Philo. Much the ſame in Effect as Table II. for having found the Time of Full Sea, or High-Water, upon the Full and Change Days by Table I. then ſeek the Age of the Moon, that Time in this Table, and the Hours and Minutes that ſtand againſt her Age in the ſecond Column hereof, which are to be added to what you found in the firſt Table, will give the Time of High-Water nearly at that Place and Time.

Tyro. Pray give me an Example.

Philo. I will.

Suppoſe the Moon 9 Days old. I demand the Time of High-Water in the *Downs*.

By Table I. The Moon being SSE, or NNW, makes a Full Sea upon full and Change Days; look in Table I. and againſt the Word *Downs* you will find 10 Hours 3 Minutes. Alſo againſt 9, her Age in Table

ble III. ſtands 5 Hours 50 Minutes, which added to 10 Hours 3 Minutes, gives 16 Hours 20 Minutes; from which take 12 (when it is above 12) there remains 4 Hours 20 Minutes, which is 20 Minutes paſt 4 in the Morning. Do you underſtand it?

Tyro. Quite well.——And now I ſhould be glad if you would ſhew me a few Queſtions in Navigation.

SECT. VII.

Of NAVIGATION.

Tyro. What do you mean by *Navigation?*

Philo. Navigation is that Branch of the Mathematics, or that Art which teaches to guide or conduct a Ship ſafely from one Port to another, or to any known Place in the World, and is built upon the Knowledge and Practice of *Geometry* and *Trigonometry*, &c.

Tyro. What are the different Methods of practical Navigation?

Philo. It is divided into three principal Parts, *viz. Plain-Sailing*, *Mercator Sailing*, and *Circular Sailing*.

1. *Of* PLAIN-SAILING.

Tyro. What do you mean by Plain-Sailing?

Philo. Plain-Sailing is the Foundation of the others, being the moſt ſimple and eaſy of all, and will do very well at or near the Equinoctial, but is more or leſs erroneous the further we are from that Line or Part of the World.

Tyro. What is the Reaſon of this?

Philo. Becauſe at, or near the Equinoctial, the Degrees of Longitude as well as Latitude, are nearly equal, but in advancing towards the Poles are not ſo.

Tyro. Pleaſe to give me an Example or two.

Philo. I will.

PROBLEM I.

Suppoſe a Ship to ſail S E by S, *(called the Rhumb or Point of the Compaſs)* 124 *Leagues, I demand her Difference of Latitude and Departure from the Meridian,* viz. *the Longitude ſhe is then in.*

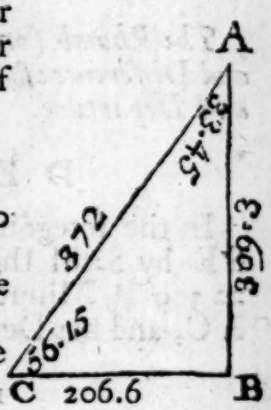
N. B.

N. B. Always remember to bring the Leagues into Miles or Minutes before you work the Queſtion.

DEFINITION.

Fig. 1.

In the Triangle ABC the Hypothenuſe AC is the Diſtance ſailed or Rhumb-Line, BC the Departure or Longitude, and AB the Difference of Latitude. Then,



1. *To find the Difference of Latitude,*
As Radius or S of 90 - - 10.00000
To the Log. of the Diſt. ſailed 372′
So is the S c of > A 56° 15′ the Courſe
To Log. of the Side AB 309′ 3
This divided by 60 gives 5° 9′ 18″ the Difference of Latitude.

2. *To find the Departure* BC *from the Meridian.*

As Radius 90
To the Logarithm of the Rhumb-Line AC 372′
So is the S of < of the Courſe of A 33° 45′
To the Logarithm of the Side BC 206 $\frac{6}{10}$ her Departure, which divided by 60 gives 3° 26′ 36″ the Difference of Longitude.

OBSERVATION.

By the firſt Operation, you may tell how far you have ſailed North or South, called Northing or Southing; by the ſecond, how far you have ſailed Eaſt or Weſt, called Eaſting or Weſting.

By GUNTER's *Scale.*

Set one Foot of the Compaſs in Radius (*viz.* at eight Points, becauſe 8 Times 11 $\frac{1}{4}$, which is one Point, is = 90), then extending the other to 372; the ſame Extent will reach from the S of Courſe A, *viz.* 33° 45′ (which is three Points) to 206 $\frac{6}{10}$ the Departure; and the Compaſſes ſtill remaining at the ſame Diſtance, will reach from the S c of the Courſe C 56° 15′ (*viz.* from 5 Points,

Points, or 5 Times 11 $\frac{1}{4}$) to 309 $\frac{3}{10}$ the Difference of Latitude = 5° 9′ 18″ as before.

N. B. This Example by *Gunter*, well underſtood, will be ſufficient for all.

PROBLEM II.

The Rhumb (or Point of the Compaſs the Ship ſails upon) and Difference of Latitude being given, to find the Diſtance and Departure.

DEFINITION.

In the foregoing Figure ABC, ſuppoſe a Ship to ſail SE by S till the Difference of her Latitude be AB = 309′ $\frac{3}{10}$ Minutes; I demand her Diſtance ſailed, *viz.* AC, and her Departure from the Meridian, *viz.* CB.

1. *To find the Diſtance.*

As Sc of > of the Courſe A 56° 15′
To the Log. of the Side AB, the Diff. of Lat. 309′ $\frac{3}{10}$
So is Radius or 90
To the Log. of the Side AC 372′
Which is the Diſtance ſailed.

2. *For the Departure.*

As the Sc of > of the Courſe A 56° 15′
To the Log. of the Side AB the Diff. of Lat. 309 $\frac{3}{10}$
So is the S of the ∠ of the Courſe A 33° 45′
To the Log. of the Side BC the Departure 206 $\frac{6}{10}$. Or,
As Radius to the Diſtance 372, ſo is the Sine of the Courſe 56° 15′ to the Departure 206 $\frac{6}{10}$

N. B. This is only the Reverſe of Problem the firſt, and therefore eaſily performed by *Gunter*'s Scale.

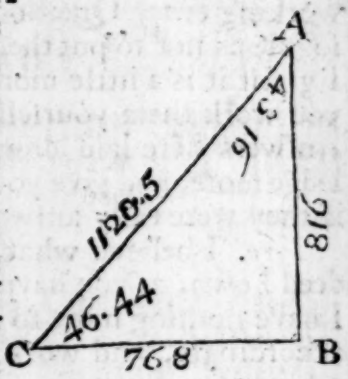
PROBLEM III.

The Difference of Latitude and Longitude being given, to find Rhumb and Diſtance.

DEFI-

DEFINITION.

Fig. 2.



In the Triangle A B C, let A repreſent any Place (ſuppoſe the *Lizard)* that the Ship is in, A B the direct Line or Parallel thereof; let the Point C be called the Iſle of *St. Mary* in the *Azores*, and C B its Meridian: Then there is given the Side A B = 816′ the Diſtance of the *Lizard* from the Meridian of *St. Mary*, or the Diſtance of Longitude; C B the Difference of Latitude 768′: Then

1. *To find the Rhumb or Angle at* C.

As the Logarithm of the Side B C 768′
To Radius —— —— 10.00000
So is the Logarithm of the Side A B 816′
To the Tangent of the Rhumb or Angle at C 46° 44′; this divide by 11 ¼ (the Degrees in one Point or Rhumb) gives 4 Rhumb Points and 1° 44′ more, which ſhews that the Rhumb or Point of the Compaſs is, from the *Lizard* to *St. Mary*'s the 4th Rhumb from that Meridian, and 1° 44′ or nearly 1 ¾ Degrees more, *viz.* S W and 1 ¾ Degrees nearly ſtill more weſterly: But if you take it from *St. Mary*'s to the *Lizard*, then it will be the oppoſite Rhumb or Point of the Compaſs, *viz.* N E and 1° 44′ more eaſterly, the Reverſe of the former.

2. *For the Diſtance* A C.

As the S of the Rhumb or < at C 46° 44′,
To the Log. of the Side A B 816′,
So is the Radius
To the Log. of the Hypoth. A C 1120 5/10, which is the Diſtance from the *Lizard* to *St. Mary*'s, the Diſtance by the plain Chart or Sailing. Do you underſtand it, *Tyro?*

Tyro. I underſtand it very well, Sir, but ſhould have been better pleaſed if you had wrought the Queſtions out at Length.

Philo.

Philo. I thought ſo with myſelf; but I aſſure you it is of more Advantage to you upon the whole; for conſider, *Tyro*, I have not left you without the Manner of working every Queſtion, and certainly you cannot be ſo idle as not to put theſe Rules in Practice; and though I grant it is a little more Trouble, yet I am ſenſible, if you work them yourſelf, and find them agreeable to the Anſwers here laid down, it will increaſe your Knowledge more, and give you ten Times the Satisfaction than if they were fully anſwered to your Hand.

Tyro. I believe what you ſay to be true, Sir, for indeed I own, as you have given all the Sides, Angles, &c. I have nothing more to do, but to find their Logarithms accordingly, and work as before: But pray then give me another Example, if it be of any further Service.

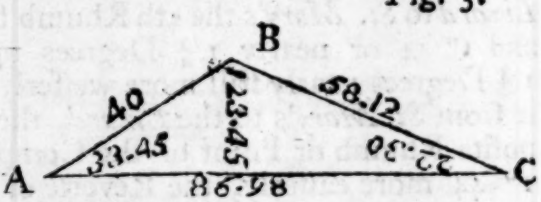
Philo. I will.

PROBLEM IV.

Two Ships ſail from a certain Port A; *one ſails* ENE 40, *the other* E *by* S, *ſo far till ſhe finds the firſt Ship to bear from her* NW *by* N; *I demand the ſecond Ship's Diſtance from the Port* A; *and their Diſtance then from each other.*

DEFINITION.

Fig. 3.



In the Triangle ABC, let A be the Port from which both the Ships ſail, AB the ENE Courſe, and AC the Courſe E by S: Then

1. *To find the Diſtance of the ſecond Ship.*

As the S of the ∠ C, 22° 30′
To the Log. of the Side AB 40′
So is the S of the ∠ at B 123° 45′
To the Log. of the Side AC 86.98, the Diſtance of the ſecond Ship from the Port.

2. *To find the Diſtance of the two Ships*, viz. *the Side* BC.

As the S of the < at C 22° 30′
To the Log. of the Side AB 40′

So

So is the S of the ∠ A 33° 45′
To the Log. of the Side B C 58.12, the Diſtance of the two Ships, *viz.* B and C.

Do you underſtand it, *Tyro?*

Tyro. Sir, I acknowledge I am not quite perfect, but I ſee the Nature and Manner of working of the Problems very plainly.

Philo. That's ſufficient; then I will ſet you a few Queſtions or Problems, by Way of Exerciſe, to which you may prefix any Angles or Numbers.

PROBLEM V.

A Ship ſails S W *by* W, *till her Difference of Longitude* (viz. *her Departure from the Meridian*) *is* 220 *Minutes, I demand the Diſtance ſailed, and Difference of Latitude.*

1. *For the Diſtance.*

As S of the Courſe S W by W, (*viz.* 56° 15′) to the Departure 220′: So is Radius, to the Diſtance 265 Minutes = 88 Leagues one Mile.

2. *For the Difference of Latitude.*

As Radius: Diſtance 265′:: Sc of 56.15, the Courſe, *viz.* 33° 45′: Difference of Latitude 147.2 Minutes, *viz.* 2° 27′ 12″.

By GUNTER.

Extend the Compaſſes from 5 Points, *viz.* 5 × 11 $\frac{1}{4}$ = 56° 15′, to the Departure 220′, this will reach from Radius, *viz.* 8 Points to 265 Minutes, the Diſtance. Again, the ſame Extent of the Compaſſes will reach from the Sc (three Points) to the Difference of Latitude 147.2 Minutes as above.

PROBLEM VI.

The Diſtance 247, *and Departure* 197 *given, to find the Courſe and Difference of Latitude.*

1. *For the Courſe.*

As the Log. of the Diſtance : Radius : : the Departure 197 : S of the Courſe 52° 54′.

2. *For the Difference of Latitude*

As Radius: Diſtance 247 :: Sc of Courſe 37° 6′ : Difference of the Latitude 149.

By GUNTER.

Extend the Compaſſes from 247 to 197, and the ſame Diſtance will reach from Radius to the Sine of the Courſe 52° 54′. Alſo the Extent from Radius to the Sc of the Courſe 37° 6′ will reach the ſame Way from the Diſtance 247 Minutes, to the Difference of Latitude 149 Minutes.

Tyro. I am obliged to you, Sir; and now pleaſe to tell me ſomething concerning what is commonly called *Mercator*'s Sailing.

Philo. It muſt be very little then, becauſe if Opportunity would allow of it, Room will not; but however I will grant your Requeſt.

2. *Of ſailing by the true Chart, called* Mercator's. *

Tyro. What do you mean by *Mercator*'s Sailing; and what is the Difference between this and Plain Sailing?

Philo. By *Mercator*'s Chart all Places are laid down with great Truth on the Globe, reſpecting both their Latitudes, Longitudes, Bearings, and Diſtance; but this is better underſtood by the following Table of Meridional Parts or Difference of Latitudes, and its Uſe applied to Practice.

* Though this is called *Mercator*'s Sailing, yet it appears by the beſt of Authors that I could ever yet ſee, that the Invention belongs to our own Countryman Mr. *Wright*.

A TABLE of MERIDIONAL MILES.

Degrees of Latitude	Minutes in each Degree.						The Difference.
	0	10	20	30	40	50	
	Meridional Miles.						
0	0	10	20	30	40	50	10
1	60	70	80	90	100	110	10
2	120	130	140	150	160	170	10
3	180	190	200	210	220	230	10
4	240	250	260	270	280	290	10
5	300	310	320	330	340	350	10
6	360	370	380	390	400	410	10
7	421	431	441	451	461	471	10
8	481	491	501	511	521	532	10
9	542	552	562	572	582	592	10
10	603	613	623	633	643	653	10
11	664	674	684	694	704	715	10
12	725	735	745	755	766	776	10
13	786	797	807	817	827	838	10
14	848	858	869	879	889	900	10
15	910	920	931	941	951	962	10
16	972	983	993	1004	1014	1024	10
17	1035	1045	1056	1066	1077	1087	10
18	1098	1108	1119	1129	1140	1150	10
19	1161	1172	1182	1193	1203	1214	10
20	1225	1235	1246	1257	1267	1278	11
21	1289	1299	1310	132	1332	1342	11
22	1353	1364	1375	1386	1396	1407	11
23	1418	1429	1440	1451	1462	1473	11
24	1484	1499	1505	1516	1527	1538	11
25	1549	1561	1572	1583	1594	1605	11
26	1616	1627	1638	1649	1661	1672	11
27	1683	1694	1705	1717	1728	1738	11
28	1751	1761	1773	1785	1796	1806	11
29	1819	1830	1842	1853	1865	1877	11

A TABLE of MERIDIONAL MILES.

Degrees of Latitude.	Minutes in each Degree.						The Difference.
	0	10	20	30	40	50	
	Meridional Miles						
30	1888	1899	1911	1923	1934	1946	12
31	1958	1969	1981	1993	2004	2016	12
32	2028	2040	2052	2063	2075	2087	12
33	2099	2111	2123	2135	2147	2159	12
34	2171	2183	2195	2207	2219	2231	12
35	2244	2256	2268	2281	2293	2305	12
36	2318	2330	2342	2355	2367	2380	12
37	2392	2405	2417	2430	2442	2455	12
38	2468	2481	2493	2506	2519	2532	13
39	2544	2557	2570	2583	2596	2609	13
40	2622	2635	2648	2662	2675	2688	13
41	2701	2714	2728	2741	2754	2767	13
42	2781	2795	2808	2822	2835	2849	13
43	2863	2876	2890	2904	2918	2931	14
44	2945	2959	2973	2987	3001	3015	14
45	3030	3044	3058	3072	3086	3101	14
46	3115	3130	3144	3159	3173	3188	14
47	3202	3217	3232	3247	3261	3276	15
48	3291	3306	3321	3336	3351	3366	15
49	3382	3397	3412	3428	3443	3459	15
50	3474	3490	3505	3521	3537	3553	16
51	3568	3584	3600	3616	3632	3649	16
52	3665	3681	3697	3714	3730	3747	16
53	3763	3780	3797	3814	3830	3847	17
54	3864	3881	3899	3916	3933	3950	17
55	3968	3985	4003	4020	4038	4056	18
56	4074	4092	4110	4128	4146	4164	18
57	4183	4201	4219	4238	4257	4275	19
58	4294	4312	4331	4351	4370	4390	20
59	4409	4428	4448	4468	4487	4507	20

A TABLE of MERIDIONAL MILES.

Degrees of Latitude.	Minutes in each Degree.						The Difference.
	0	10	20	30	40	50	
	Meridional Miles.						
60	4527	4547	4567	4588	4608	4629	20
61	4649	4670	4691	4711	4733	4754	21
62	4775	5796	4818	4839	4861	4883	22
63	4905	5927	4949	4972	4994	5017	22
64	5039	5062	5085	5108	5132	5155	23
65	5179	5203	5226	5250	5275	5299	24
66	5324	5348	5373	5399	5423	5449	25
67	5474	5500	5526	5552	5578	5604	26
68	5631	5658	5685	5712	5739	5767	27
69	5795	5823	5851	5879	5908	5937	28
70	5966	5996	6025	6055	6085	6115	30
71	6146	6177	6208	6239	6271	6303	31
72	6335	6368	6401	6434	6468	6501	33
73	6535	6570	6605	6640	6675	6710	35
74	6747	6783	6820	6857	6895	6933	37
75	6972	7010	7050	7089	7130	7170	40
76	7211	7253	7295	7338	7381	7424	43
77	7469	7514	7559	7605	7651	7698	46
78	7745	7795	7844	7894	7944	7996	50
79	8048	8100	8154	8209	8264	8320	55
80	8377	8435	8495	8555	8616	8678	60
81	8742	8806	8872	8939	9007	9077	68
82	9148	9221	9295	9371	9449	9528	77
83	9609	9692	9778	9865	9954	10046	88
84	10141	10238	10338	10441	10546	10656	105
85	10770	10887	11007	11133	11263	11398	128
86	11539	11686	11839	11999	12168	12344	165
87	12521	12718	12927	13150	13388	13644	230
88	13920	14221	14550	14914	15324	15783	
89	16318	16950	17726	18729	20152	22623	

Tyro. What is the Uſe of this Table?

Philo. The Uſe is to find the Meridional Miles and Parts in any Latitude, or between two given Places differing in Latitude, as follows:

1.

If one Place is under the Equator, and another North or South Latitude, then the Number anſwering to the laſt is the Meridional; thus the Difference between the Meridional Miles under the Equator, which obſerve is (o) and in N. Latitude 52° is 3665 Miles; and in 25° S. Latitude it is 1549 Miles; as you will find to ſtand right againſt theſe Numbers, 25 and 52.

2.

If two Places have both North or both South Latitude, then the Meridional Parts or Miles belonging to each ſubtracted, will give the Meridional Difference of Latitude in Miles. Thus, ſuppoſe one Place 52° North which is 3665′) the other 40° N. (which is 2622′) their Difference is 1043 the Meridional Difference, *&c.*

3.

If one Place be North, and the other South Latitude, then add their Meridional Parts together gives the Meridional Difference: Thus, in 52 North the Miles anſwering in the Table are 3665; and againſt any other Number at Pleaſure (ſuppoſing 40 South) ſtands 2622; this added to 3665 North, gives 6287, the Meridional Difference of Latitude. And thus for any Places.

Tyro. This is eaſy enough; but pray can't you give me an Example or two at large?

Philo. I will do any thing to ſerve you, but it will be proper firſt of all to give you an Example of the Uſe of the Table.

The Uſe of the TABLE.

Suppoſe one Place in 21° North Latitude, the other in 52° N. What is the Meridional Difference of Latitude in Miles?

The

The Meridional Parts of 52° are - -	3665
The Meridional Parts anſwering to 21° are	1289
Difference	2376

N. B. If one had been North and the other South, then add them: 52° N. and 21° S. is only adding the above Numbers together anſwering thereto, which is 4954.

PROBLEM I.

Having the Latitude and Diſtance of two Places, to find the Rhumb and Difference of Longitude.

1. *To find the Rhumb or Courſe.*

As the Diſtance to Radius, ſo is the Difference of Latitude to the Sine Complement of the Rhumb required: Then,

2. *To find the Difference of Longitude.*

As Radius to the Difference of Latitude in Meridional Parts, ſo is the Tangent of the Rhumb, to the Difference of Longitude required.

PROBLEM II.

The Latitudes and Difference of Longitude of any two Places, to find the Rhumb and Diſtance.

1. *To find the Rhumb.*

As the Meridional Difference of Latitude in Miles to Radius, ſo is the Difference of Longitude in Miles, to the Tangent of the Rhumb required.

2. *To find the Diſtance.*

Firſt find the Difference of Latitude in the common Way, and bring it into Miles, by multiplying by 60; then ſay,

As the Sine Complement of the Courſe, to the proper Difference of Latitude in Miles, ſo is Radius to the Diſtance in Miles.

PROBLEM III.

Having the Latitude and Rhumb of two Places given, to find their Diſtance, and Difference of Longitude.

1. *To find the Diſtance.*

As the Sine Complement of the Courſe to the Difference of Latitude, ſo is the Radius to the Diſtance.

2. *To find the Difference of Longitude.*

As Radius to the Difference of Latitude in Meridional Parts, ſo is the Tangent of the Rhumb to the Difference of Longitude required.

PROBLEM IV.

Having the Rhumb, Diſtance, and one Latitude given, to find the other Latitude with the Difference of Longitude.

1. *To find the other Latitude.*

As Radius to the given Diſtance, ſo is the Sine Complement of the Rhumb, to the other Latitude required.

2. *To find the Difference of Longitude.*

As Radius to the Difference of Latitude in Meridional Parts, ſo is the Tangent of the Rhumb, to the Difference of Longitude required.

PROBLEM V.

Having the Difference of Longitude, the Rhumb, and one Latitude given, to find the Diſtance and other Latitude.

1. *To find the other Latitude.*

As the Tangent of the Rhumb to the Difference of Longitude in Parts, ſo is the Radius to the Meridional Difference of Latitude in Parts required.

2. *For the Diſtance.*

As the Sine Complement of the Rhumb to the Difference of Latitude, ſo is the Radius or Sine of 90, to the Diſtance required.

Theſe

Theſe Problems, *Tyro*, you may eaſily try by any Numbers you pleaſe; and therefore, I ſhall now give you an Example or two in Circular-Sailing.

3. *Of* CIRCULAR-SAILING.

Tyro. What do you mean by Circular-Sailing?

Philo. Circular-Sailing is ſailing by the Rules of *Spherical Trigonometry*, or by the Knowledge of Spherical Circles, and therefore muſt be the moſt exact Way, and beſt Method of all others.

Tyro. Then I perceive that Plain-Sailing only ſuppoſes the Earth to be like a Circle or plain Superfices.

Philo. You ſay right, and therefore plain *Trigonometry* will anſwer all ſuch Queſtions; and from hence it may very properly be ſaid to ſail, or to ſuppoſe to ſail in Plano, or otherwiſe Plain-Sailing.

Tyro. But pray how is it poſſible to keep ſailing for any conſiderable Diſtance, exact in the Arch of a great Circle?

Philo. 'Tis impoſſible to keep quite cloſe to this Method, becauſe of the Roughneſs of the Sea at different Times and Places, and the Uncertainty of the Wind, *&c.* but yet, Circular Sailing is of great Advantage, particularly in long Voyages, that have direct *Eaſt* and *Weſt* Courſes.

Tyro. Pray tell me, in ſhort, what the Difference is then between Circular-Sailing and the two former?

Phil. In *Plain* and *Mercator's* Sailing, *Meridians*, Rhumbs and Parallels are uſed as the Sides of Triangles, but in *Circular Sailing* the Rhumbs are uſed as Heli-Spherical Lines, but the Parallels are not uſed as the Sides, becauſe they are not the Arches of great Circles. In ſhort, in Circular Sailing, the *Meridian*, or Arches of *Meridians* and Equinoxial, are uſed to form, or make a Triangle agreeable to, and anſwer every Courſe and Diſtance.

Tyro. I underſtand your Meaning very well; but are there no Rules firſt to be known before we begin to work any Problems?

Philo. I ſee no Occaſion for any, as you have before been taught *Geography*; however, obſerve,

1. Should two or more given Places lie under the Equinoxial, or in equal Parallels thereto, then is their Poſition Eaſt and Weſt; therefore the Difference of their Longitudes converted into Miles gives their proper Diſtance. And,

2. Should they lie under the ſame Meridian, (*viz.* North and South of each other) then their Difference in Degrees converted into Miles tells the Difference of their Latitude.

PROB. I.

Let there be two Places (or two Ships at Sea) lying in the ſame Latitude, and let the Difference of the Longitude be given; it is required to find the neareſt Diſtance from each other in the Arch of a great Circle, and the true or direct Poſition or Situation from each other.

1. *For their neareſt Diſtance.*

As Radius to the Sc of the given Latitude; ſo is the S of $\frac{1}{2}$ the Difference of Longitude, to the S of $\frac{1}{2}$ the Diſtance required, the Double of which gives the Diſtance required.

2. *For the direct Poſition or Situation.*

As Radius, to the S of Latitude; ſo is the Tangent of $\frac{1}{2}$ the Difference of Longitude, to the Sc of the < Poſition required.

PROB. II.

Suppoſe two Ships (or two Places) are one under the Equinoxial, the other in any given Latitude, with the Difference of Longitude being given; it is required to find firſt, The Diſtance from each other; 2. The direct Poſition or Situation from the firſt to the ſecond, and alſo the direct Poſition or Situation in reſpect of each other.

1. *To find the neareſt Diſtance.*

As Radius to the Sc of the Difference of Longitude, ſo is the Sc of the Difference of Latitude, to the Sc of the Arch of the Diſtance required.

2. *To*

2. *To find the Poſition from the firſt to the ſecond Place.*

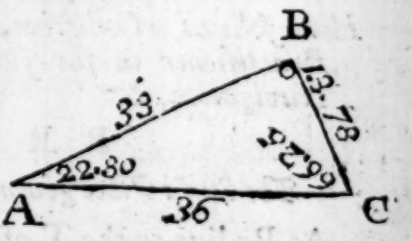
As Radius to the S of the Difference of Latitude, ſo is the T c of the Difference of Longitude, to the T c of the Angle of Poſition.

3. *For the Poſition from the ſecond to the firſt Place.*

As Radius to the S of the Difference of Longitude, ſo is the T c of the Difference of Latitude, to the T c of the Angle of Poſition.

PROB. III.

Coming off the main Ocean, I had the Sight of a Cape, and intended to ſail to it; I find it to bear from me NNW, *and by Computation* 33 *Miles Diſtance. But having continued my Courſe* N. *for* 36 *Miles from this Obſervation; I there anchored: Now I deſire to know how the ſaid Cape now bears, and its Diſtance from me?*



In the annexed Figure or Triangle ABC, I ſuppoſe the Ship to be at A, and the Cape B, to bear from me NNW 33′; then ſailing from my firſt Station A, to the ſecond Station at C, 36 North, I would then know the Diſtance and Bearing of the Cape B from the Point C.

1. In this Triangle are given AB=33, AC=36, and the Angle A=22° 30′.

To find the Angle at C.

As the Sum of the Sides AC and AB, to the Difference of the ſame Sides, ſo is the T of ½ the unknown ∠'s, B and C, *viz.* 78° 45′, to the T of 12° 20′, which taken from 78° 45′, leaves 66° 25′ for the Angle at C; ſo that the Bearing of the Cape B from C, is 1° 5′, WSW. Do you underſtand me?

Tyro. Very well, except it be, I don't know from whence the above 78° 45′ comes from, nor the laſt 1° 5′, the Bearing.

Philo. I am ſurprized to ſee you at a Loſs in Things ſo plain. Obſerve then the Angle A=22° 30, then

muſt the other 2 ∠s B and C be = 157° 30′, becauſe 157° 30 + 22° 30′ = 180° = to all the <s of any Triangle; now the ½ of 157.30 = 78° 45′, and the Tangent found is 12° 20′. But every Point or Rhumb of the Compaſs, if you remember, is 11° 15′, therefore 12° 20′ — 11° 15′ = 1° 5′, the Bearing of the Cape B from C from the W to the S, *viz.* W S W.

Tyro. I thank you, Sir, and am now quite ſatisfied with the whole Operation.

Philo. Then I'll proceed,

2. *To find the Diſtance* B *from the Ship at* C.

As the S of the < 66° 25′, to the Log. of the Side AB 33′, ſo is the S of the Angle at A 22° 30′, to the Log. of the Side BC 13′ 78″; ſo that the Cape is diſtant rather more than 13¾ Miles.

SECT. VIII.

Here follows a Collection of Problems proper for the young Practitioner in the further Knowledge of Aſtronomy, Navigation, &c.

PROB. I.

The Sun's Place given, to find his right Aſcenſion.

As Radius to the T of the Sun's Longitude from the next Equinoxial Point, ſo is the Sc of his greateſt Declination, to the T of his right Aſcenſion from the next Equinoxial Point.

PROB. II.

The Declination of the Sun being given, to find the Sun's Place or Longitude from Aries.

As the S of the ☉'s greateſt Declination, to Radius; ſo is the S of his preſent Declination to the S of the Sun's Place.

PROB. III.

The ☉*'s Declination given, to find his right Aſcenſion.*

As Radius to the Tc of the Sun's greateſt Declination; ſo is the T of the given Declination, to the right Aſcenſion, from ♈ or ♎ as required.

PROB.

PROB. IV.

The Latitude and Sun's Declination given, to find the Aſcenſional Difference.

As Radius to the Tc of the given Latitude, ſo is the T of the Sun's Declination given to the S of the Aſcenſional Difference required in Degrees and Minutes, which converted into Time (as in Prob. 16. p. 212.) gives the Time the Sun riſes or ſets after Six o'Clock.

PROB. V.

To find the Sun's oblique Aſcenſion and Deſcenſion.

1. Find his Right-Aſcenſion by Prob. 1. and his Aſcenſional Difference as in the laſt; then obſerve, if his Declination be North, to ſubtract the Aſcenſional Difference out of his Right-Aſcenſion in the 6 northern Signs, and it gives the oblique Aſcenſion; but added to the Right-Aſcenſion, gives the oblique Deſcenſion.

2. But ſhould the Sun have a South Declination, then add the Aſcenſional Difference to the Point given in the 6 ſouthern Signs to the right Aſcenſion, gives the oblique Aſcenſion, but ſubtracted from the ſame gives the oblique Deſcenſion.

PROB. VI.

The Latitude and Sun's Declination given, to find his Amplitude.

As the Sc of the Latitude, to Radius; ſo is the S of the Sun's Declination, to the S of the Amplitude from the Eaſt and Weſt Point of the Horizon.

N. B. This Problem is of great Uſe for finding the Variation of the Needle; for the Sum or Difference of the Sun's Amplitude, and Magnetic Amplitude (according as it may happen) gives the Variation required.

PROB. VII.

Having the Sun's Amplitude from the North Point, and his Declination given, to find the Latitude.

As the Sc of the Amplitude from the North Point, to Radius; ſo is the S of the given Declination, to the Sc of the Latitude required.

PROB.

PROB. VIII.

The Latitude and Sun's Declination given, to tell on any Day what Time the Sun will be upon the true Eaſt and Weſt Points.

As the T of the Latitude, to the T of the Sun's Declination; ſo is Radius, to the Sc of the Hour from Noon.

PROB. IX.

The Latitude and Sun's Declination given, to find his Altitude at Six o'Clock.

As Radius to the Sun's Declination, ſo is the S of the given Latitude to the Sun's Altitude at Six.

PROB. X.

The Latitude and Sun's Declination given, to find the Azimuth at Six o'Clock.

As Radius to the T of the Sun's Declination, ſo is the Sc of the Latitude of the Place, to the T of the Azimuth ſought.

N. B. This Problem is of great Uſe to find the Poſition or Declination of any Place from the North and South in order to fix a Sun-Dial.

PROB. XI.

Having the Latitude and Sun's Declination, to find his Altitude on the Eaſt and Weſt Points.

As the S of the Latitude to Radius, ſo is the S of the Declination to the S of the Sun's Altitude at due Eaſt and Weſt.

PROB. XII.

The Latitude given, to find the Sun's Altitude at any Time.

As Radius : Tc of the Latitude : : the S of the Sun's Diſtance from Six o'Clock : T of a 4th Arch, which being taken out of the Sun's Diſtance from the Pole, gives a 5th Arch: Then ſay,

As

As the Sc of the 4th Arch thus found: Sc of the remaining or 5th Arch : : the S of the Pole's Height of Latitude : S of the Sun's Altitude all the Time required.

PROBLEM XIII.

The Sun's Declination, Altitude, and Hour from Noon given, to find the Azimuth.

As the Sc of the Sun's Altitude: S of the Hour from Noon : : the Sc of the Sun's Declination : S of the Azimuth required.

PROBLEM XIV.

The Sun's Altitude, Declination and Azimuth given, to find the Latitude.

As the S of the Sun's Azimuth : S of his Diſtance from the North Pole : : the S of the ∠ of the Sun's Poſition : Sc of the Latitude required.

PROBLEM XV.

Having the Latitude given, as alſo the Sun's Altitude and Hour from Noon, to find the Angle of the Sun's Poſition.

As the Sc of the Sun's Altitude : S of the Hour from Noon : : the Sc of the Latitude to the S of the < of the Sun's Poſition.

PROBLEM XVI.

To find what Angle the Ecliptic makes with the Meridian.

As Radius : S of the Sun's greateſt Declination : : Sc of the Sun's Right Aſcenſion from the next Equinoxial Point : Sc of the < of the Ecliptic with the Meridian.

PROBLEM XVII.

Having the Sun's Altitude, Declination, and Azimuth, to find the Latitude.

As the S of the Sun's Azimuth : S of his Diſtance from the N. Pole : : the S of the Angle of the Sun's Poſition : Sc of the Latitude required.

N. B.

N. B. Here follows a Collection of Problems relating to Aſtrology, rather for Curioſity than any immediate Dependance upon future Events; though many of them are not without their Advantages, nor altogether without ſome Certainty, if what the Problem is built upon is true, both as to Circumſtance and Time, in which Caſes many natural Preſages and Predictions have happened according to ſuch and ſuch Calculations.

PROBLEM XVIII.

The Diſtance of the Sun, from either of the Equinoxial Points ♈ or ♎, being given, to find its Declination.

As Radius or S of 90 : S of the Sun's Diſtance from the next Equinoxial Point :: the S of the Sun's greateſt Declination : S of his preſent Declination.

PROBLEM XIX.

To find the Quantity of any Angle of the 12 Houſes, or the Quantity of the Angles which the Circles of the 12 Houſes make with the Meridian.

As Radius : Tang. of 30 for the 2, 6, 8, and 12th Houſe (or the Tang. of 60 for the 3d, 5th, 9th, and 11th Houſe) :: the Sc of the Pole : Tc of any Houſe with the Meridian.

N. B. The 1ſt Houſe is called the Horoſcope or Angle of the Eaſt; the 7th Houſe the Angle of the Weſt; the 4th the Angle of the North; and the 10th the Angle of the South.

PROBLEM XX.

To find the Right Aſcenſion of the Point of the Equinoxial called Medium Cœli.

Find the Sun's Right Aſcenſion, then reduce the Time from Noon laſt paſt into Degrees, and add this to the Sun's Right Aſcenſion; and the Sum ſhall be the Right Aſcenſion of the Point then in the Equinoxial, which is called *Medium*, or *Cor Cœli*.

PROBLEM XXI.

To find the Angle of the Ecliptic with the Horizon.

As Radius : Sc of the Altitude of *Cor Cœli* :: the S. of the < of the Ecliptic with the Meridian : Sc of the < of the Ecliptic required.

PROB.

PROBLEM XXII.

Having the Altitude of Medium Cœli, *and the Angle of the Ecliptic with the Meridian given, to find the Diſtance of the Azimuth from the Meridian, otherwiſe the Amplitude Ortive of the Aſcendant *, or Horoſcope.*

As Radius or S of 90° : S of Medium Cœli : : the T of the < of the Ecliptic with the Meridian : T c of the Amplitude Ortive of the Aſcendant.

PROBLEM XXIII.

Having the Angle of the Ecliptic and the Altitude of Medium Cœli given, to find the Cuſp of the firſt Point of any of the 12 *Houſes.*

N. B. The Amplitude Ortive of the Aſcendant is equal to the Diſtance of the Azimuth of 90 from the Meridian, therefore the Cuſp or Aſcendant Degree of the firſt Houſe is thus found.

As Radius or S of 90 : Sc of the < of the Ecliptic with the Meridian : : the Tc of the Altitude of Cor. or Med. Cœli to the T of the Diſtance of Med. Cœli from the Aſcendant Degrees.

PROBLEM XXIV.

To find the Altitude of the Pole above any of the Circles of the 12 *Houſes.*

N. B. If the Angle of the Circle of the Houſe be not given, find it by Problem 19th. Then,

As Radius : Sc of < of the Circle of the given Houſe : : S of the Pole's Elevation or Latitude : S of the Altitude of the Pole above the Circle of Poſition of any given Houſe.

* The Aſcendant is that Degree of the Equator which riſes the Time any Perſon is born, &c. and Horoſcope is that Degree of the Aſcendant, or that Star or Planet which riſes, and which is then taken Notice of in order to predict any Event, or calculate the Time and Circumſtance of future Events.

PROBLEM XXV.

Having the Latitude and Declination of any fixed Star given, to tell when it will be due Eaſt and due Weſt.

As the S of the Pole's Altitude : Radius : : the S of the Star's Declination : S of the Star's Elevation above the Horizon, upon the true Eaſt and Weſt Points.

PROBLEM XXVI.

To find the Moon's Horizontal Parallax.

As the Diſtance of the Moon from the Center of the Earth : Earth's Semi-Diameter : : Radius or S of 90 : S of the Moon's Horizontal Parallax in that Diſtance.

PROBLEM XXVII.

Having the Moon's Altitude and Horizontal Parallax given, to find her Parallax in any apparent Latitude.

As Radius : S of the Moon's Altitude : : the S of her Horizontal Parallax : the S of her Parallax in that Altitude and Latitude.

THE

THE YOUNG MAN's Book of Knowledge, &c.

PART VI.

Of MUSIC and VIBRATIONS, &c.

N. B. This little Treatiſe being already extended beyond its original Deſign, the Author propoſes to treat more particularly upon the Theory of Muſic only; which will be of as great Service to many that can already play and ſing well, as to thoſe who have at preſent little or no Knowledge of this Science. For it is to be noted, that a Perſon may poſſibly know a great deal of *Muſic*, who can neither ſing nor play; and may alſo ſing and play very well, without being a proper Judge of the Reaſon of Harmony. This being evident, I ſhall endeavour to make the following Pages ſerviceable to the Lovers of Muſic in general.

Tyro. WHAT is *Muſic?*

Philo. Muſic, ſtrictly ſpeaking, ſignifies only true Harmony of Sounds, and is one of the liberal Sciences, which teaches us the Manner of ſinging or playing right, according to the Rules of Compoſition; but, in general, it is uſed for all Manner of Sounds, whether by Nature or Art; and the Study and Practice of it has ever been counted both uſeful and diverting, freeing the Mind from every Thing which may preſs too hard, or dwell too long upon it, and mightily diſſipates anxious and melancholy Thoughts, helps to accelerate Buſineſs, and if properly and ſeaſonably uſed, enlivens the whole Man.

Tyro. What is the firſt neceſſary Step towards learning *Muſic?*

Philo. To get the following Gamut (or the Gamut in Table I.) by Heart.

The *Gamut* or *Scale* of MUSIC. (See Table I. and II.)

G—*ſol-re-ut*	— in alt.	—	*ſol*	Treble or Tenor	
F—*fa-ut*	—	—	* *fa*		
E—*la*	—	—	* *la*		
D—*la-ſol*	—	—	*ſol*		
C—*ſol-fa*	—	—	*fa*		
B—*fa-b-mi*	—	—	* *Mi* or Mee ‡		
A—*la-mi-re*	—	—	*la*	Counter Tenor	
G—*ſol-re-ut*	— gs : Treble	—	*ſol*		
F—*fa-ut*	—	—	* *fa*		
E—*la-mi*	—	—	* *la*		
D—*la-ſol-re*	—	—	*ſol*		
C—*ſol-fa-ut*	— Tenor	—	*fa*		
B—*fa-b-mi*	—	—	* *Mi* ‡		
A—*la-mi-re*	—	—	*la*	Baſs	
G—*ſol-re-ut*	—	—	*ſol*		
F—*fa-ut*	— Baſs	—	* *fa*		
E—*la-mi*	—	—	* *la*		
D—*ſol-re*	—	—	*ſol*		
C—*fa-ut*	—	—	*fa*		
B—*mi*	—	—	* *Mi* ‡		
A—*re*	—	—	*la*		
Gamut	—	—	*ſol*		

1. *Explanation of the foregoing* GAMUT. *See alſo* Plate I. Tables I. *and* II.

Tyro. You ſay it is neceſſary to learn the *Gamut* by Heart, but pleaſe firſt to tell me how I am to begin.

Philo. You may begin at the bottom Line of the Baſs as it ſtands, and learn the Notes from *Gamut* up to G *ſol-re-ut* in *alt*; or you may learn the *Baſs* firſt, and then the *Treble*, &c. which you like beſt.

Tyro. Pleaſe to explain a little further what you mean by learning each Part ſeparate.

‡ Mi is always pronounced like Mee.
* N. B. The Stars ſhew the Place of the Semitones.

Philo.

Philo. You are to note, *Tyro*, that there are always five Lines ruled on Paper, on purpoſe to place the Notes upon; or elſe in the Space-ways between them, according as the Nature of the Tune requires.

Tyro. This I know very well, Sir.

Philo. Then it can be no hard Taſk to underſtand the foregoing *Gamut*; for if you obſerve, it is divided into three Parts, *viz.* *Treble* or *Tenor*, 2. the *Counter Tenor*, and 3. the *Baſs*. Every one of theſe contain five Lines, and four Space-ways between thoſe Lines, (as appears by the crooked Lines which are placed on the right Hand, and hooks in, or circumflexes each Part ſeparately) now begin with any one of them upon the firſt or bottom Line of the five, and call the Note by its Name, then go to the firſt Space-way that lies between the bottom Line and the ſecond Line, and ſo go on till you come to the top Line of each; thus will you ſoon know what the Name of the Notes are in any one or all the Parts.

Tyro. I underſtand you.——Suppoſe then I begin with the *Baſs*. I ſay the firſt Note on the firſt Line is *Gamut*, the firſt Space-way is A-*re*, the ſecond Line B-*mi*, the ſecond Space-way, or Space between the two next Lines is C-*fa-ut*, the third or middle Line D-*ſol-re*, the third Space-way E-*la-mi*, the fourth Line F-*fa-ut*, the fourth or upper Space-way G-*ſol-re-ut*, and the top or upper Line A-*la-mi-re*. Is this right?

Philo. Very right; proceed then.

Tyro. There is no Occaſion, I think, *Philomathes*, to ſay any more upon a Thing ſo plain; for I perceive the firſt Line of the Counter Tenor begins at, or is counted from the fourth Line of the *Baſs*, *viz.* at F-*fa-ut*, and ſo goes on till it comes into the ſecond Line of the *Tenor* or *Treble*, *viz.* to G-*ſol-re-ut*; and I alſo as plainly ſee, that the *Tenor* or *Treble* have alſo five Lines and four Space-ways; the firſt Line of which is E-*la-mi*, the firſt Space-way is F-*fa-ut*, the ſecond Line G-*ſol-re-ut*, and ſo I go on, Line and Space-way, till I come to G-*ſol-re-ut* in alt.

Philo. You are right, *Tyro*, but yet you need not get thoſe *cramp* Words by Heart; there is a much ſhorter and eaſier Way, which anſwers the ſame End: For, obſerve,

obſerve, as every eighth Note in *Muſic* has the ſame Effect of Sound upon the Ear, by Reaſon of its being the moſt perfect Concord to the eighth below, or above it; ſo the eight Letters of the Alphabet ſerve very pertinently to expreſs the eight Notes of Muſic; and they never go any farther than from A to G, and then you begin at A again, and ſo go on to G, if there be ever ſo many aſcending Notes: But, 2. Becauſe the Learner ſhould not miſtake, it is better that he ſhould begin to learn G at firſt than to come back in the Alphabet to A, (for that is the next after G) then B, then C, then D, *&c.* in all aſcending Notes; but if you begin at G and deſcend to lower Notes, then only count backwards in Order, as thoſe Letters ſtand in the Alphabet, *viz.* G, F, E, D, C, B, A, and then the next G again, *&c.* as before. (See Table II.)

Tyro. Sir, I am much obliged to you. This is eaſy enough; I am ſure any Body may ſoon learn the Name of the eight Notes, if this be all.

Philo. This is all; and if you look into Table I. you will ſee that the Notes are the ſame there as here, only placed in another Order; but every Letter of the Alphabet ſtands againſt the Name of the Note by which it is called.

Tyro. I ſee it plain enough, but what do you mean by this Star (*) between ſome of the Notes, both in this *Gamut* and in the Scale, Table I.

Philo. The Star is placed between thoſe Notes which are but half a Note or Semitone diſtant in Sound from each other; and if you obſerve, there are but two Half-notes or Semitones in the whole Gamut; and that is from B to C, and from E to F.

Tyro. Are the Half-notes always between theſe Letters?

Philo. No: They are only common to the natural Order of the Gamut; but they become variable or ſhiftable by the Affection of *Flats* or *Sharps*, placed on different Lines or Space-ways, which you will ſee the Reaſon of, when we come to ſpeak of the various *Keys* in *Muſic*.

Tyro. I am ſatisfied; but pray what do you mean by *ſol-fa*, *&c.* in the Gamut.

Philo.

Philo. This and ſeveral other Things are better explained by the Table in the Copper-plates annexed, of which we ſhall ſpeak in their Order.

Explanation of TABLE I. PLATE I.

This Table or Scale has eleven Lines like the foregoing Gamut, and is in Effect the ſame as the other, containing Treble, Tenor, and Baſs; each of which has five Lines, by running one into another: The firſt Line of the Baſs begins at *Gamut* or G, and aſcends ten Notes to B; the firſt Line of the Tenor, (called ſometimes *Counter Tenor*) begins at the fourth Line of the Baſs, *viz.* at F, and aſcends alſo ten Notes till it comes to A, or the ſecond Space-way in the *Treble*; and the firſt Line of the *Treble* begins at E, and aſcends to G, in alt.——You may ſee, therefore, very plainly, that from *Gamut* (or G) the firſt Note of the Baſs, to F the firſt Note of the *Tenor*, there are ſeven Notes in the natural Order of the Gamut or Scale itſelf; and alſo from F, the firſt Note of *Tenor*, to E, the firſt Note of the *Treble*, are contained the ſame; both of which in *Muſic* are commonly expreſſed a Seventh diſtant one from another: This plainly ſhews, that though the firſt ſeven Letters in the Alphabet expreſs the firſt ſeven Notes in Order ſo taken, yet to make up the whole Octave or eight Notes, the firſt Letter which we begin with muſt be repeated again and included: Thus from A to A, B to B, C to C, *&c.* both included, make eight Notes or a perfect Octave, as appears more plain by Table II.

Of TABLE II. PLATE I.

In this Table, *Tyro*, you have the Names of the Notes of both the other Gamuts diſtinct in their Order and Parts, with the Names of the Notes under each, beginning at G, *&c.* ſo that any one may learn the eight Notes in any one of the Parts in a very ſhort Time.

Tyro. It is very plain indeed; but what do you mean by *ſol-fa*, as I obſerved before?

Philo. There is really no Occaſion for the Rules of *ſol-fa* or *ſol-faing* (as it is commonly called) to underſtand the Notes, or to learn to ſing, becauſe the whole Art of Singing depends upon knowing where the different Semitones

mitones lie in every Key, and that may be done with much more Eaſe than *ſol-faing*.

Tyro. I thought it was univerſally approved of, in the Practice of vocal Muſic, eſpecially in Pſalm Tunes and Church Muſic.

Philo. No doubt but it may be of ſome Uſe in Pſalmody, eſpecially to all ſuch as have no Maſter to teach them any other Method: But don't you know that it is a Maxim, and a ſelf-evident Principle, in Arithmetic and the Mathematics, that *that* Rule or Axiom which will not always hold good, is no Rule or Axiom at all.

Tyro. But why does not the Rules of *ſol-faing* hold good, as it ſhews the Place of the Semitones in any Key, according to Table II. and V.

Philo. I grant that from [mi to fa] and from [la to fa] are only Semitones; but you ſee how ſhiftable Mi is, and therefore, as this mechanical Sound governs the Place of all the reſt, it is ſtraining the Memory of Perſons in general; and you ſhall find very few of what we call the tip-top Church Singers, who are able at Sight to ſol-fa a Tune in above two or three of the moſt common Keys, though they have laboured hard for Years; others even who know the Tune before-hand are not able to ſol-fa it in other different Keys; which ariſes, as I ſaid, from the perpetual changing of Mi, from one Line or Space-way to another: But even *this* is not all; there is a worſe Objection ſtill.

Tyro. What is that?

Philo. I told you before, that *that* is not worthy to be called a Rule that cannot always be put in Practice without a Contradiction to itſelf: Now, I grant a Perſon may ſol-ſa a Pſalm Tune ſet in *Minums*, or perhaps being perfect, may, in very ſlow Movements, ſol-fa Crotchets; but how is he to ſol-fa a Diviſion or *Run* (as it is commonly called) in Quavers; and how much leſs then, will he be able to expreſs thoſe articulate Words of ſol-la-mi-fa, when there happens to be a Run of Semi-quavers? Now, though he may ſing the *Minums* right by this Rule, yet if he cannot perform the Whole by the ſame Rule, it is evident that he muſt either perform it ſome other Way, or elſe leave it imperfect.——Beſides this, you will find, that the Practitioners

titioners of Pſalmody in general, will allow that there requires a great deal of Time to ſol-fa Tunes in the various Keys common to Pſalmody: Now, it is worthy Notice to obſerve, that if it be difficult and burthenſome to the Memory to ſol-fa in the moſt eaſy Keys, (which are common to Pſalm Tunes) how much more burthenſome to the Memory muſt it be to do it in all the various Keys in Muſic.

Tyro. It is very true what you ſay, Sir; but though this Rule cannot be well put in Practice with Quavers and Semi-quavers, yet I ſuppoſe you will grant it is very practicable and certain in ſlow Movements.

Philo. Practicable in a great Meaſure it may be, but I will not ſay certain, were it for this Reaſon only; that it is poſſible a Perſon may ſol-fa ten Tunes right, one after the other, by calling every one of the Notes according to the Order of the Words, and yet not ſing the Tunes right, becauſe he may as well ſound a whole Note from mi to fa, or from la to fa, as he may from ſol to la; nay, I aſſure you, I have often heard it done, and therefore, I only mention it that I would not have the Learner think that 'tis impoſſible to ſing a Tune wrong, becauſe he names or pronounces ſol-la-mi-fa right by Name, and eſpecially when the Notes lie cramp and at a Diſtance from each other.

Tyro. If this be the Caſe then, what Method is the Learner to take to come to a greater Certainty?

Philo. There can be no better Way than by obſerving the exact Places of all the Flats and Sharps in the various Keys, which ſoon may be done, and there are many odd Words or Syllables to be found which are much more practicable in ſinging than ſol-fa; but more of this by and by.

Tyro. Well, for my own Part, I know nothing of Muſic, and only ſpeak what I have heard others ſay concerning ſol-faing; however, I know the Names of all the Notes in every Line and Space-way, and ſhould like to know more if you would take the Trouble to inſtruct me.

Philo. That I will, with all my Heart; and as you ſay you know the Names of the Notes, A B C D E F

and G in every Line and Space-way, the next Thing you muſt underſtand is,

Of TABLE III. PLATE I.

Of the dividing of Notes in Time according to their Names.

This Table contains five Sorts of Notes by Name, and is equal every Way, as appears at Sight. The firſt Note is called a *Semibrieve* (that is, half a Brieve, a Note now ſeldom uſed) which contains two Minums, one Minum contains two Crotchets, one Crotchet two Quavers, one Quaver contains two Semiquavers, ſo that the Table is equal every Way, one Semibrieve containing two Minums or four Crotchets, or eight Quavers, or ſixteen Semiquavers; that is, ſixteen Semiquavers, eight Quavers, *&c.* are played to the Time of one Semibrieve.

Tyro. I underſtand you well.

Of TABLE IV. PLATE I.

Philo. A Dot made after a Note makes it half as long again in Time as it was before, and is commonly called a *prick'd Note:* Thus, a *prick'd* or *dotted* Minum makes or contains three Crotchets; a *prick'd* Crotchet makes three Quavers, and a *prick'd* Quaver makes three Semiquavers, *&c.*

TABLE V. PLATE I.

Tyro. What is the Uſe of this Table?

Philo. This ſhews you the different Reſts or Pauſes in Muſic; the two firſt broad Strokes drawn from, or extended through two Space-ways, or three Lines, ſtand for eight Bars Reſt, and wherever this Mark is found, either in *vocal* or *inſtrumental* Muſic, it ſignifies that Part is to reſt or ſtop eight full Bars; the next broad Stroke only extends to two Lines or one Space-way, and ſignifies two Bars Reſt, or a Pauſe in that Part reſting two Bars, and ſo on with the reſt, which the Table itſelf ſufficiently explains.

Tyro. It is plain and eaſy enough to be underſtood.

TABLE VI. and VII. PLATE I.

Tyro. I ſee theſe two Tables ſhew the Concords and Diſcords; but what Uſe am I to make of this?

Philo. As you have done, or ought to do with all other, to get them ſo by Heart as to know the Nature of Concords and Diſcords in general, what Notes are ſuch by Compariſon, and what are really not of either Sort.

Tyro. But how can I be a Judge in this reſpect?

Philo. That is a Queſtion I cannot reſolve at preſent; it muſt be the Effect of Time and Obſervation to make you Maſter of this; but ſtill it is proper you ſhould know before-hand what are real Concords of themſelves, and what are Diſcords to thoſe Concords.

Tyro. I ſuppoſe you now ſpeak of Muſic in two or more Parts.

Philo. Moſt certainly I do; for there can be no Diſcords in any ſingle Part of Compoſition, becauſe every Air or Tune is abſolute; but when another Part is added, that is, when there are other compound Notes to be played with the firſt Part, or any two Parts or Sounds to be played or ſung together, *then* the proper Concords or Diſcords will evidently appear, and even a good Ear (though no great Judge) will eaſily diſcover the Difference, and whether the Diſcords are out of their proper Place.

Tyro. Why, then, I perceive you allow of Diſcords ſometimes.

Philo. No doubt of it: It would be a very heavy Piece of Compoſition that had not this Mixture; but then the Difficulty lies to know where they are to be properly introduced, to make the Harmony yet more complete and agreeable; but this I ſhall endeavour to explain by and by, if I have Room: However, for the preſent, you may obſerve thus much, that the *fourth* reckoned from any Key-note downwards, becomes an Accompaniment to the *ſixth* from the ſame Note; and the *ſixth* from the upper Note or Key-note above it, will become only a *third* from the *eighth* below the original Key-note: Therefore, if you begin below upon

the Octave Key-note and aſcend, the ſame Notes will now become third, fifth, and eighth; which before, in deſcending, were fourth, ſixth, and eighth, to the Key-note above them: In this Caſe, a fourth becomes a proper Concord, becauſe it is a perfect fifth from the Octave below.

Tyro. I don't quite apprehend you; pray give me an Example.

Philo. Suppoſe then I begin at A, and want to make all the proper Chords downward to A, I ſay that E C and A will be a fourth, ſixth and eighth to the A above them; but if I begin at A below, and want the proper Chords or Concords to it upward, I then find that C E and A will be a third, fifth, and eighth, which are the very ſame Notes as before, only differently named: This will appear evidently to any one who knows the leaſt of Muſic, or is acquainted ever ſo little with the Nature of the Keys or Notes of any Organ or Harpſichord, &c.

Tyro. I do not quite apprehend you at preſent.

Philo. But you will eaſily perceive it, if you do but conſider well what I have told you, and mind what is laid down in the next Table, where the Keys of the Inſtrument and their correſpondent Notes conſpicuouſly appear to every diligent Reader.

TABLE VIII. PLATE II. FIG. I.

Of the Diatonic Scale, *ſhewing the Reaſon of the natural Production of the various Tones and Semitones, from the Laws of Proportion and Vibration.*

Tyro. Though I underſtand the Notes very well, yet I confeſs I know nothing of this Table, nor what you mean by Proportion of Sounds at preſent.

Philo. May be ſo; but you will ſoon underſtand it if you give but the leaſt Attention to the Explanation. Obſerve then, and look on the Figure while you read.—1. Let S C S repreſent a Scale divided into 100 equal Parts, and let any Note in the Gamut or Scale be drawn up to any Tone or Pitch at Pleaſure——But that the Definition may appear more clear, we will take the natural

tural eight Notes, or the Notes of the natural Key, beginning at C, with the proper Semitones, till you come to its Octave C, or an eighth higher; which Octave contains thirteen different Sounds, or twelve Semitones included.

2. Let then the Line CCC be equal to the Key or firſt Note C, and alſo equal to the Scale itſelf S C S of 100 Parts; then the Length of any other Note will very eaſily be found as follows, *viz.*

3. As the Denominator of any Note is to its Numerator, ſo will the original Scale or Denominator 100 be to the Length of the String of any Note required.

4. Now, in the Scale of Chords and Diſcords, there is a Compariſon made of the Octave, double Octave, treble Octave, *&c.* which when underſtood, the fractional Parts or Intervals of the Diatonic Semitones, throughout the whole Scale, are found by the Rule of Proportion only: For,

5. Though twice 8 is 16, and three Times 8 is 24, four Times 8, 32, *&c.* in common Multiplication, yet it is not ſo in the Doctrine of Sounds; for in Muſic 2 8ths or 2 Octaves make but 15; three Octaves make but 22, and four Octaves but 29 whole Notes; the Reaſon is evident, becauſe the laſt Note of every Octave is always counted the firſt Note of the next Octave.

6. This being conſidered, we muſt now ſee the neceſſary Fractions in the Intervals of the Octave; and as every whole Note contains two Semitones, it will follow that there muſt be twelve Semitones in the natural eight Notes, becauſe there are two half Notes included, *viz.* From E to F, and from B to C natural, as appears from Plate I. Table I.

7. Now it is evident that theſe twelve different Semitones muſt have a Proportion of Sound between the firſt original Note C, and its Octave C, and every one of them muſt be a fractional Part of the Octave, or double Octave: Thus the greater or ſharp 7th would be $\frac{7}{5}$, but is more properly called $\frac{15}{16}$ to avoid Fractions in the different Numerators. Let us then,

8. Suppoſe the firſt Note C equal to the Scale of 100, then the Fraction will be $\frac{100}{100} = \frac{1}{1}$, equal to Unity itſelf, or the firſt original Tone from whence the reſt

muſt be calculated; therefore every next aſcending Semitone muſt be more acute, and of Conſequence a Part of the whole Scale.

9. The Fractions then for all the Sounds in the *Diatonic* Scale will ſtand thus in Order, $\frac{1}{1}$, $\frac{15}{16}$, $\frac{8}{9}$, $\frac{5}{6}$, $\frac{4}{5}$, $\frac{3}{4}$, $\frac{5}{7}$, $\frac{2}{3}$, $\frac{5}{8}$, $\frac{3}{5}$, $\frac{5}{9}$, $\frac{8}{15}$, and $\frac{1}{2}$. To find the Length of the String or Chord in Proportion, obſerve,

10. As the Denominator of every or any of the Fractions, is to its reſpective Numerator, ſo is the whole Scale of 100-Parts to the Length of the Chord or String belonging to it. For Example: I would know the Length of the Strings which ſhall properly vibrate to bring out the Tones of $\frac{8}{9}$ and $\frac{4}{5}$, with the correſpondent Notes belonging thereto. I only ſay, as 9 : 8 :: 100 : 88.8 equal Parts out of the Scale of 100, which in the Table anſwers to the Note D, or whole Tone from C. Again, as 5 : 4 :: 00 : 80, which anſwers to the Note E, being the greater Third from C. And thus may any Note or Tone, half Note, or Semitone, be found; either the Length productive of ſuch a Tone or Note, or the Note requiring ſuch a Length.

11. Hence then it appears, that all Notes which vibrate $\frac{1}{1}$ are Uniſons, and all which vibrate $\frac{1}{2}$, or as 2 to 1, are Octaves; and that all ſuch which vibrate any otherwiſe, are certain Notes having a Compariſon between $\frac{1}{1}$ and $\frac{1}{2}$.

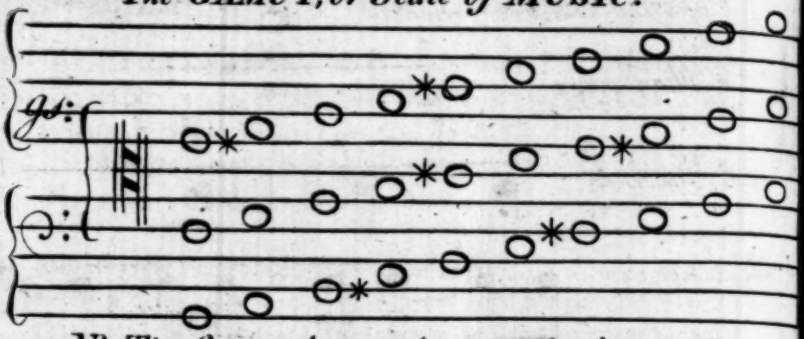
12. Therefore, ſuppoſed it were required to find a true harmonical Mean between Uniſon and Octave; add the Numerators and Denominators together, you have $\frac{2}{3}$, which in the Table anſwers to G, the perfect 5th from C, or perfect 4th from its Octave C.

13. Again, to find the greater *Third*. Thus $\frac{1}{1} \times \frac{2}{3} = \frac{2}{3} \times \frac{2}{4} = \frac{4}{5}$. Now $\frac{4}{5} = \frac{1}{1} \times \frac{2}{3}\frac{1}{1}\frac{2}{5} = \frac{4}{5}$ or 80 Parts, which anſwers in the Scale to the greater Third, *&c.*

14. Thus may any harmonical Mean be found between any two extreme Notes: For let x and e repreſent two Extremes, and let it be required to find m the Mean, it is evident to any Perſon that underſtands the leaſt of *Algebra*, or the true Order of the Laws of Proportion, that the Mean will be $m = \frac{2xe}{x \times x}$. Thus,

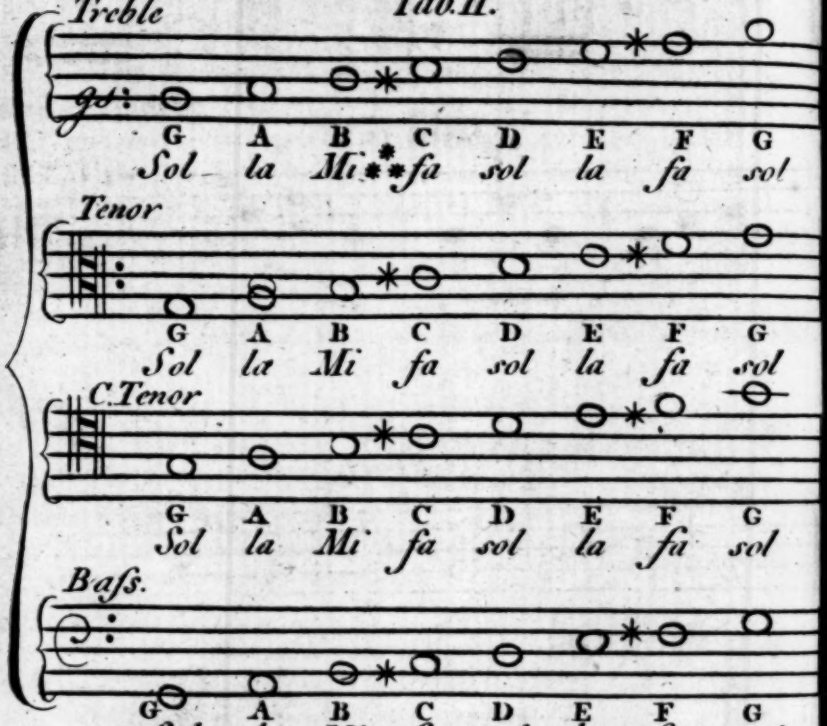
for

Tab. I.
The GAMUT, or Scale of MUSIC.



NB. The Stars shew where the Semi-tones lie

Tab. II.



NB. ** Mi is pronounced soft like Me.

Tab. V. Of the Reſts in Muſic.

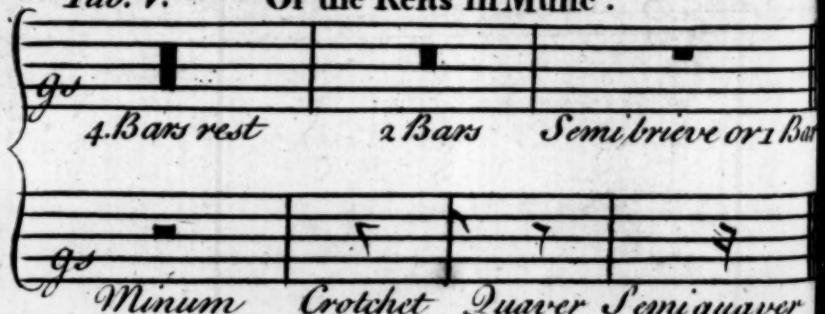


Table III.

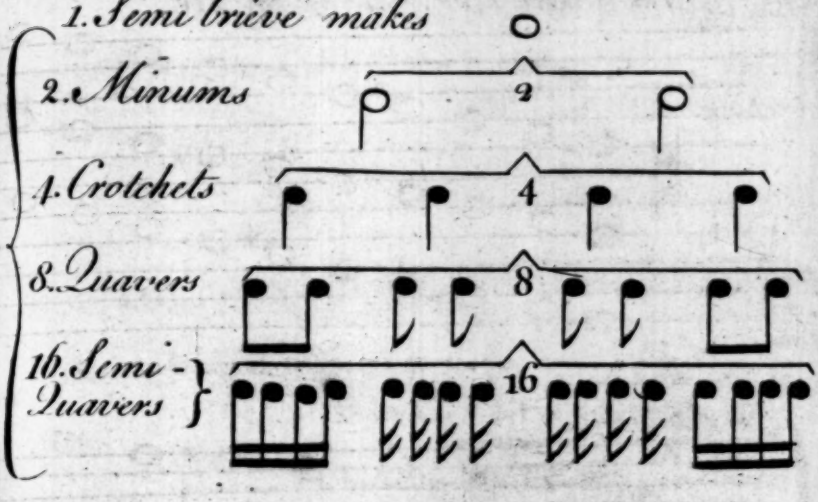
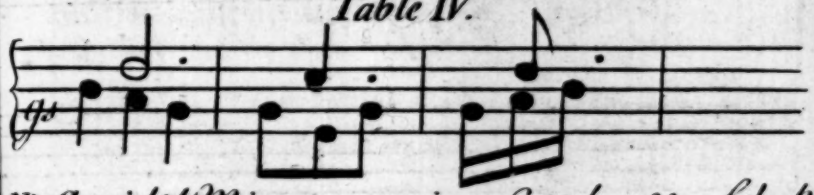
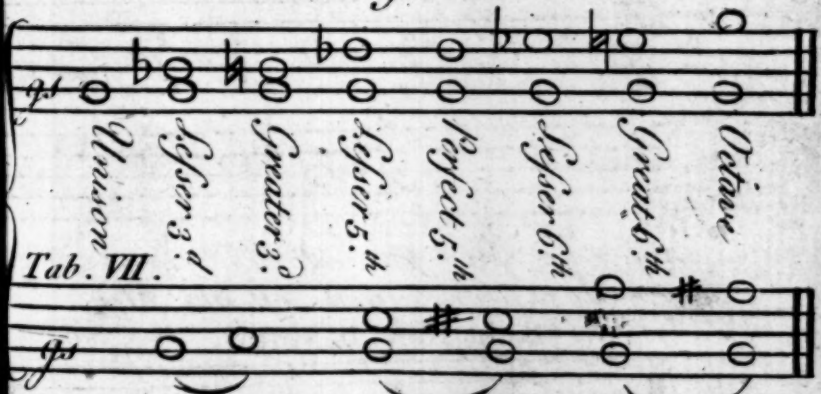


Table IV.



N.B. A prick'd Minum contains 3 Crotchets &c. of the Rest

Table VI. Of Concords.



Tab. VII.

for Example, multiply the Extremes by 2, and divide the Product by the Sum of the Extremes, and you will have the harmonical Mean.

Thus between Uniſon and Octave.

Firſt, $2 \times 1 = 2 \times = 4$; this $\div 2 + 1 = 1''3$ the harmonical Mean; that is, 2.1 3 and 1, are the three Terms, which being multiplied by the Denominator of the Mean Fraction, will produce 6.4. and 3, whoſe Ratios are 3 : 2 and 4 : 3; the firſt of which anſwers to the 5th, and the other to the 4th in the Diatonic Scale.

15. But in order to find all the real Chords, there need only be drawn a ſimple Line, which being divided into four Parts only, will diſcover the Length of the Uniſon, Octave, and all the intermediate Chords; and nothing can be wanting but common Apprehenſion to underſtand it.

A further Explanation *of the* Diatonic Scale. Plate II. Fig. II.

Let the Line A B repreſent a Scale of 100 equal Parts, the ſame as the Diatonic Scale itſelf. Let A B be divided into two equal Parts in C, then divide C B into two equal Parts in D, and alſo divide C D into equal Parts in E, then you will have the following Proportions.

1	As A B : A C	: : 2 : 1	the Octave
2	A D : A C	: : 3 : 2	the perfect 5th
3	A B : A D	: : 4 : 3	the perfect 4th
4	A E : A C	: : 5 : 4	the greater 3d
5	A E : A E	: : 6 : 5	the leſſer 3d
6	A E : E B	: : 5 : 3	the greater 6th
7	A B : A E	: : 8 : 5	the leſſer 6th

N. B. The Diſcords 2d, or 9th; Sharp 4th, Natural 7th, or Sharp 7th, may be found by the ſame Compariſon or Proportion: Do you underſtand me, *Tyro*, or not?

Tyro. I will not ſay I am quite Maſter of what you ſay, but I will take Care to look it over again very attentively; and therefore if you have any Thing further to add, I beg you will proceed to inſtruct me.

Philo. The next Thing then, *Tyro*, is to underſtand the Nature of the various Keys in *Muſic*, for upon this, and

and keeping good Time, depends the whole practical Part.

2. *Of the different Keys.* PLATE II. FIG. III.

Tyro. What do you mean by the Keys in Muſic?

Philo. The Key-note, which gives Motion to all the reſt, and in the Baſs always ends in the Key, or on the Key-note itſelf.

Tyro. How many Keys are there in the natural Order of the *Gamut?*

Philo. Strictly ſpeaking there are no more than *two, viz.* C natural, the ſharp Key; and A natural, the flat Key; all other Keys beſides being only *artificial, viz.* made by the different Diſpoſition of Flats and Sharps, on the different Lines and Space-ways.

Tyro. What do you mean by a *flat* and a *ſharp Key*; and why is C called a *ſharp Key*, and A a *flat Key?*

Philo. On account of the greater or leſſer Third from the Key-note itſelf; for a *ſharp* Key has the greater Third, or two whole Tones or Notes from the Key-note; but the *flat* Key has the leſſer Third, which contains only *one* whole Tone and a Semitone, which is deficient or leſs than the ſharp Key by *one* Semitone.

Tyro. I own I never knew this before, for I have heard others ſay, and always thought ſo myſelf, that *that* was a ſharp Key when *Sharps* were ſet at the Beginning, and a *flat* Key when it had *Flats.*

Philo. But I hope you ſee the contrary now. Do you not?

Tyro. Very plainly; and I perceive alſo very plainly, that every Key after C, and every Key after A, is only the ſame two Keys moved one Line and one Space-way higher at Pleaſure, with ſuch proper Flats and Sharps to make them have the ſame Third; and I ſuppoſe this is what is called *Tranſpoſition*; is it not?

Philo. Yes, and nothing is eaſier; for ſuppoſe I found a Tune in C flat, and wanted to ſet it five Notes higher or four Notes lower, which is the ſame; then I find I muſt ſet it in G or Gamut Sharp, having a Sharp on F only, as the Table plainly ſhews; if I want it ſix Notes

Notes higher, or a Third lower, which is A, then I find three Sharps are neceſſary, *viz.* one on G, one on F, and one on C; if I want the Tune a greater Third higher, *viz.* in E, I find four Sharps are neceſſary, *viz.* one on G, one on F, one on D, and one on C; but if I want it a leſſer Third higher, *viz.* in E flat, then I find three Flats neceſſary, *viz.* one on E, one on B, and one on A, which is ſtill a ſharp Key as before, becauſe from E flat to G natural is greater Third, the ſame as from E natural to G ſharp, or from C natural to E natural. The ſame is to be obſerved in tranſpoſing from flat Key to flat Key, due Regard being had alſo to move all additional Flats and Sharps, as many Notes higher or lower as you tranſpoſe to;——but Practice and Obſervation are the chief Things.

Tyro. I underſtand you, Sir; and have you any Thing farther to ſay concerning the Keys?

Philo. Only this, that all artificial Keys ending on the natural Keys of a Harpſichord, or the natural Letter itſelf, are, for Diſtinction ſake, called *perfect artificial Keys*; thoſe which end on the half Notes, or between any two natural Notes, are called *imperfect artificial Keys*, and ſuch are thoſe which have the Stars over them in the Plate.

Tyro. You have ſufficiently defined what I wanted concerning the Knowledge of flat and ſharp Keys: But pray are theſe all the Keys?

Philo. Theſe are the Names of thoſe that are conſtantly uſed both in *vocal* and *inſtrumental* Muſic.—— Some indeed have ſaid there are 96, others 72 Keys; however it is evident there are 48; *viz.* 24 *flat*, and 24 *ſharp* Keys; but as there is no Uſe for more than I have inſerted, I omit the others, being uſeleſs.

Tyro. I am obliged to you, Sir; and pray what is the next more neceſſary Thing in the Practice of *Muſic?*

Philo. One more ſo neceſſary, that without it all the Performance, though ever ſo right in reſpect of Flats and Sharps, would be but conſtant Claſhing and Confuſion.

Tyro. What can this be then?

Philo. It is the keeping of *good* or *true* Time.

Of

Of TIME.

Tyro. What do you mean by *Time* in *Muſic?*

Philo. That perfect Regulation by which every preceding Bar (from Bar to Bar) throughout any Piece of Muſic, is performed exactly in the ſame Space of Time as the preceding Bar, or Bar before.

Tyro. I ſuppoſe you call the Bars thoſe perpendicular Strokes drawn croſs the five Lines; and if I apprehend you, you mean that if one Bar has but 2 or three Notes, and the next 6, 8, 10, *&c.* the Bars muſt ſtill be performed in the ſame Time, becauſe they are equal, according to Plate I. Fig. 4.

Philo. Your Notion is very juſt.

Tyro. How many Sorts of Time are there?

Philo. Strictly ſpeaking but two, *viz. Binans* or common Time, and *Trenary* or *Triple Time.*

Tyro. Why are they ſo called?

Philo. 1. *Binary* ſignifies to *riſe* and *fall* equal, or to divide every Bar in Muſic into two equal Parts, beating with the Hand or Foot half the Quantity down and half up, or by the Pendulum of a Clock, *&c.* 2. *Trenary* Time is divided as 2 to 3; that is, into three equal Parts, two Parts of which are played or ſung with the Foot down, and the other Part with the Foot or Hand up.

Tyro. By what am I to know or diſtinguiſh common Time, and the Meaſure?

Philo. By obſerving what follows.

Of COMMON TIME. See PLATE II. FIG. IV.

Tyro. What are the Marks, Signatures, or Characters of *common Time?*

Philo. They are certain Characters ſet before the Tune, by which the Movement is duly regulated.

Tyro. I perceive then there are four Sorts of common Time; pray explain them.

Philo. The firſt of theſe Characters of itſelf ſignifies the ſloweſt of all the Movements, and has four Crotchets in every Bar (or Notes equal to them) and is generally placed at the Beginning of all *Adagio's*, *Largo's*, or very

ſlow

ſlow Parts. The ſecond Character is the moſt common in vocal and inſtrumental Muſic in general; it has alſo four Crotchets in a Bar, and its Movement is half as faſt again as the former. The third and fourth Characters denote a very quick Movement, and are generally ſet before Pieces of Muſic or Tunes called *Gavots*; and the only Difference between them is, the firſt has in general four Crotchets in a Bar, but the other never but two in a Bar, and is ſometimes called *retortive* Time.

Tyro. I am obliged to you, Sir; and now pray what are the Characters belonging to *Trenary Meaſure*, or *Triple Time?* See Plate II. Fig. IV.

Philo. There are nine Characters, or rather fractional Figures, *viz.* firſt $\frac{3}{1}$, which ſignifies three Minums in a Bar; $\frac{3}{4}$, which has three Crotchets in a Bar; $\frac{3}{8}$, which contains three Quavers in a Bar; theſe are beat or meaſured two Parts of the Bar down and one Part up: 2dly, $\frac{6}{4}$, which has ſix Crotchets in a Bar, and beat like common Time, three down and three up; that is, half the Bar down and half up; $\frac{6}{8}$, ſignifies ſix Quavers in a Bar, three down and three up; $\frac{9}{4}$, ſhews there are nine Crotchets in a Bar, ſix down and three up; $\frac{9}{8}$, is nine Quavers in a Bar, ſix down and three up; $\frac{12}{4}$, ſignifies twelve Crotchets in a Bar, ſix down and ſix up; and $\frac{12}{8}$ ſignifies twelve Quavers in a Bar, ſix down and ſix up. Do you underſtand me?

Tyro. Yes, very well; but how am I to know whether I play or ſing Time too faſt or too ſlow?

Philo. Good Time or true Meaſure is not determined by one Perſon's ſinging or playing faſter than another. Maſters of vocal or inſtrumental Muſic often ſing and play the ſame Thing faſter or ſlower than one another; nay, even themſelves ſingly will do ſo at different Times of performing.

Tyro. If ſo, how am I ever to judge of their Time?

Philo. Not by their performing faſter or ſlower at one Time than another, but by their performing every Bar throughout in the ſame Space of Time; if this is done, the Performer is a good Timeiſt; for it is not to be ſuppoſed, that any one would pretend to ſing or play Minums or Crotchets (in the ſame common Time) as faſt

faſt as poſſible; nor would they be ſo fooliſh to play a quick Movement (ſuch as Jiggs and Minuets ſet in Quavers) as ſlow as a Pſalm Tune.

Tyro. I underſtand you very well, Sir; and if you have Time and Room, I would beg Leave to intreat you, to tell me ſomething concerning a *thorough* Baſs, for I never could conceive the Reaſon of the Figures ſtanding over the Baſs.

Philo. To underſtand a *thorough* Baſs well requires Practice, but when it is underſtood, it diſcovers the Beauty and Harmony of all the Parts, and in ſhort is the Foundation of Compoſition itſelf, as you may ſee by what follows.

4. *Of a* THOROUGH BASS.

Tyro. What do you mean by a *thorough* Baſs?

Philo. Sometimes it is taken for a continual Baſs running through the whole Piece, without any Bars reſting or pauſing; but more ſtrictly it ſignifies *that* Baſs in Muſic which has Figures ſet over or under the Notes. The Notes themſelves are played with the left Hand upon the Harpſichord, or any key'd Inſtrument, and the Figures over the Notes are played with the right Hand to fill up the other Parts of the Compoſition.

Tyro. Can you give me ſome ſhort Rules whereby I may gain a little Knowledge of this Art.

Philo. I can, but ſhort they will be; but it is to be obſerved, that before you can underſtand them well, you muſt be well acquainted with the Nature of Flats and Sharps, and the various Notes in the different Keys.

Short RULES *for a* THOROUGH BASS.

Rule 1. When you are playing a *thorough* Baſs, and there are no Figures ſet over the Baſs Note or Notes, then it ſignifies that you are to play the perfect or common Chords to ſuch Notes, *viz.* the 3d, 5th, and 8th.

Rule 2. The Foundation of the true Knowledge of a *thorough* Baſs very much depends upon knowing what Chords and Diſcords depend upon all the Intervals of eight Notes in either of the natural Keys. Thus ſuppoſe

poſe I pitch upon C natural in the Baſs, and diſcerned eight Notes in Order of the Gamut; I ſay, the Key-note itſelf will have 3d, 5th, and 8th; that is, E, G, and C, will be the common Chords to it.

Rule 3. If I begin at C and find a common Chord to it, is 3d, 5th, and 8th; then if I aſcend one Note higher in the Baſs to D, the former Chords, 3d, 5th, and 8th, to C, will now become 7th, 4th, and 2d to D; alſo 6th, 3d, and 8th to E; 7, 5th, and 2d to F; 6th, 4th, and 8th to G; 7th, 3d, and 5th to A; and 6th, 4th, and 2d to B.

Rule 4. The Accompanyments of the Figures that are Diſcords, ſuch as the 2d; then obſerve, if the Treble or leading Part be a Minum, and the Baſs contains two Crotchets, the firſt of which is a common Chord, and the next deſcends one Note; then the ſame Chord is continued with the right Hand while the Baſs deſcends, and will become 2d, 4th, and 6th, to the ſame Note;——but if the Baſs lies ſtill, *viz.* has the ſame Note continued by a Hold or Circumflex from Bar to Bar, and the Minum, or 2d Minum, has a Figure of 2 ſet over it, or by the Side, then you muſt accompany that 2d with a perfect 4th, or a ſharp 4th, according to the Key you are playing in; but in this Caſe the 4th ought to be ſet down with the 2d, which is often neglected, to the great Hurt of Learners.

Rule 5. If you ſee a 4 and a 6 over any Note, count only four Notes, and ſix Notes from the Baſs Note itſelf according to the Order of the Key, and put the 8th to them for an Accompanyment.

Rule 6. When you find 6 and 4, and 5 and 3 over one Note of the Baſs, then play 6, 4, and 8, the Half of that Note, and 3d, 5th, and 8th, to the other Half; this often happens within three Notes of the Cloſe; in ſuch Caſes the 6th and 4th are reſolved into the 5th and ſharp 3d.

Rule 7. An imperfect or flat 5th is accompanied with a 3d, and ſo is a 6th, when it has no other Figure placed with it.

Rule 8. When you meet with a 4 and a 5 over one another, and a ſharp Flat natural, or Figure of 3 by the Side of the 4, that ſhews that the 4th is to be reſolved

into the 3d accordingly; this happens generally before Cadences or Cloſes, eſpecially when the 4th is to be reſolved into the Sharp 3d, as in Rule the 6th.

Rule 9. The 7th is always accompanied with the 3d, and often with the 5th, as occaſion may require; the 5th being neceſſary in ſome Caſes, in others it is too heavy. Secondly, When the Baſs aſcends by 4ths, or deſcends by 5ths, you generally ſee the Notes with 7's over them. Thirdly, When the Baſs deſcends Half a Note (into any Note which is ſharped) the 3d Note before the Cloſe, it is generally marked with a flat 7th, flat 5th and 3d, but the 7th in this Caſe is more properly called an *extreme* flat 7th, being no more in Quantity of Semitones than a perfect 6th, though called a 7th, on account of the Key. Fourthly, When the Baſs deſcends Note by Note, then you will generally find a Figure of 7 and 6 after it over every Note, which ſhews you are to play a 7th and a 3d to Half the Time of the Baſs-Note, and then reſolve or convert the 7th into the 6th, (according to the Nature of the Key you play in) ſtill continuing the 3d for the other Half of the Time.

Rule 10. When the Baſs moves by even Quavers, ſuch as 4 or 8 in a Bar, it is common to play the firſt two Quavers to the Chord of the firſt Note, and the next two to the Chord of the 3d Note, or to ſuch Figures and Accompanyments belonging to the firſt and third Notes, except it be figured to the contrary.

Tyro. I am obliged to you for your kind Inſtructions, but I cannot ſay I underſtand them at preſent.

Philo. I do not expect you ſhould: It is to be ſuppoſed you ſhould know ſomething more of the Harpſichord, and be firſt of all more acquainted with the Nature of the various Keys in general, and the natural Order and Diſpoſition of Flats and Sharps in each. Nothing of this Sort can be underſtood without *this*; and even *then*, without Practice and Obſervation, you would be at a Loſs; though the Rules I have laid down are very plain to be underſtood by any one who has a mind to learn, and pay a due Attention to what he reads: But it is too common a Practice juſt to read an Author careleſly over, and then unjuſtly to ſay, That he

he has treated ſo dark and intricate upon the Subject that they can't underſtand it.

Tyro. It is very true, Sir, but you ſhall never have that to ſay of me. I can ſay, I have always attended to your Inſtructions, and I will try, at all proper Opportunities, to make myſelf Maſter of what I am ſtill deficient in.

Philo. I make no Doubt of it, *Tyro*; and it is for the Sake of ſuch diligent and induſtrious Learners as you, that every Author takes Pains, and they are happy in ſuch Pupils, and take a Pleaſure to ſay, that you have done great Honour to them, as well as Service to yourſelf.

Tyro. I am obliged to you, kind *Philomathes*, for your Opinion of me; this encourages me to aſk you a further Favour, and that is, to give me one Example or Movement in a thorough Baſs; for though I do not now immediately underſtand it, yet I poſſibly may.

Philo. It is very true; Labour (it is ſaid) overcomes all Things; but I rather would chuſe to ſay, *Delight* conquers all Undertakings; and as I have found you, my dear *Tyro*, purſuing earneſtly after Truth and Knowledge, it gives me Pleaſure to inſtruct you, and you have your Deſire in this Reſpect alſo, by one full Example of a thorough Baſs, Plate II. Fig. 5. And now, *Tyro*, what would you have more?

Tyro. I am ſatisfied, Sir, with what you have inſtructed me in; and give me Leave to repeat once more, that I promiſe to peruſe every Thing you have treated of till I am Maſter of it; and therefore beg you would receive my hearty Thanks for your indulgent Favours.

Philo. You are quite welcome; and to give *you* further Encouragement in the Progreſs of this innocent and uſeful Science, I here preſent you with a Hymn in four Parts, which has been highly approved of, and I hope will be agreeable to you and your Acquaintance.

An Hymn, *or Song of Thankſgiving on Account of the memorable Victory gained by the King of* Pruſſia *over the* Auſtrians *near* Lignitz, *on the* 15*th Day of* Auguſt, 1760. [See the Muſic, Plate III.]

I.

To celebrate thy Praiſe, O Lord,
We will our Hearts prepare;
Repeat. To all the liſt'ning World thy Works,
Thy wond'rous Works declare.

II.

The Thoughts of them ſhall to our Souls
Exalted Pleaſure bring;
Repeat. While to thy Name, O thou Moſt High,
Triumphant Praiſe we ſing.

III.

All thoſe who have his Goodneſs prov'd,
Will in his Truth confide;
Repeat. Whoſe Mercy ne'er forſook the Man
That on his Help rely'd.

IV.

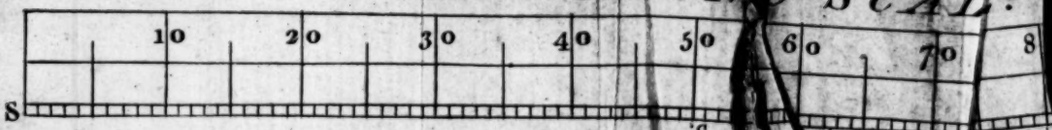
Sing Praiſes therefore to the Lord,
From Zion his Abode;
Repeat. Proclaim his Deeds till all the World
Confeſs none other God.

Hallelujah.

N. B. Every Verſe is to be ſung quite through ſoftly, in two Parts only, and then repeat the two laſt Lines in full Chorus loud.

FINIS.

THE DIATONIC SCALE.



C ♮	1/1	100		Parts Unison
C ♯ D ♭	15/16	93	75	Semitone
D ♮	8/9	88	6	Tone
D ♯ E ♭	5/6	83	3	Semiditone
E ♮	4/5	80		Ditone
F ♮ E ♯	3/4	75		Diateſsaron
F ♯ G ♭	5/7	71	4	Semediapente or Tritone
G ♮	2/3	66	6	Diapente
G ♯ A ♭	5/8	62	5	Hexachord Minor
A ♮	3/5	60		Hexachord Major
A ♯ B ♭	5/9	55	5	Sept Minor
B ♮	8/15	53	3	Semi Diapason Sept Major
C ♮ B ♯	1/2	50		Diapason Octave

Fig. 2

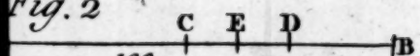


Fig. 3.

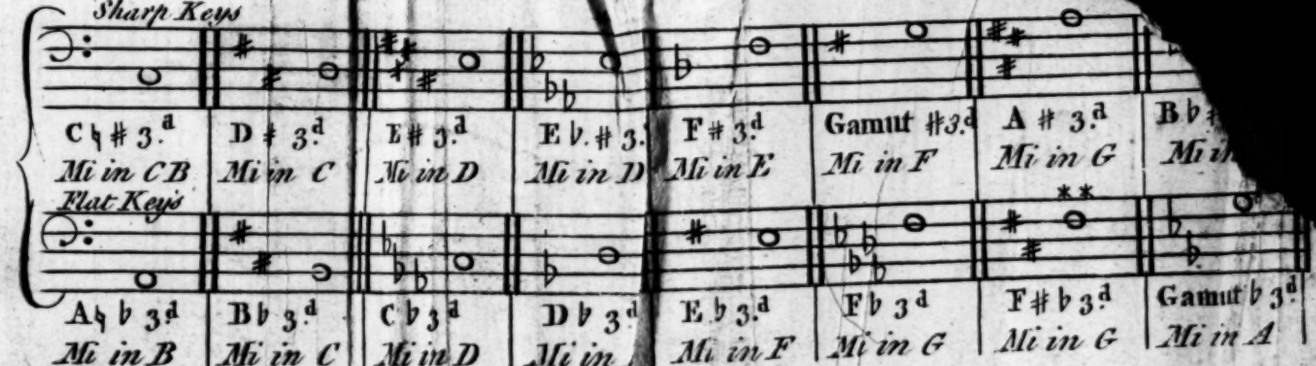
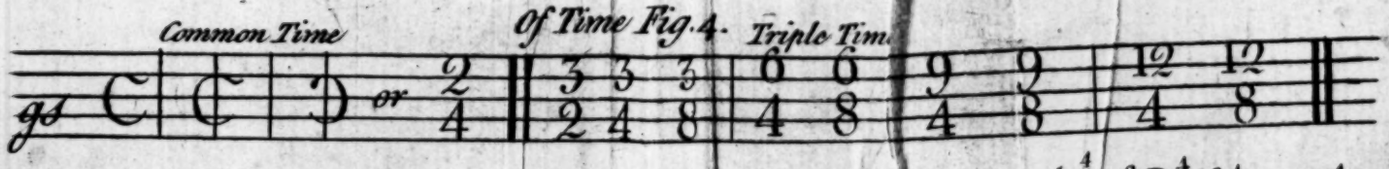
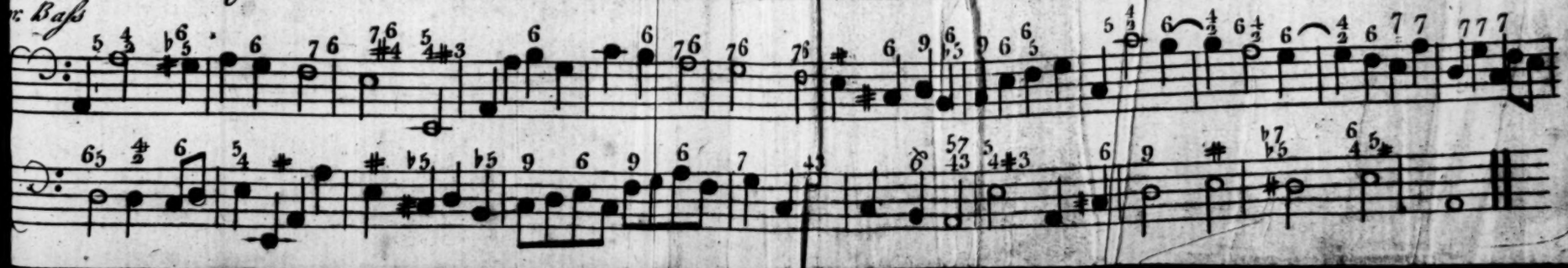
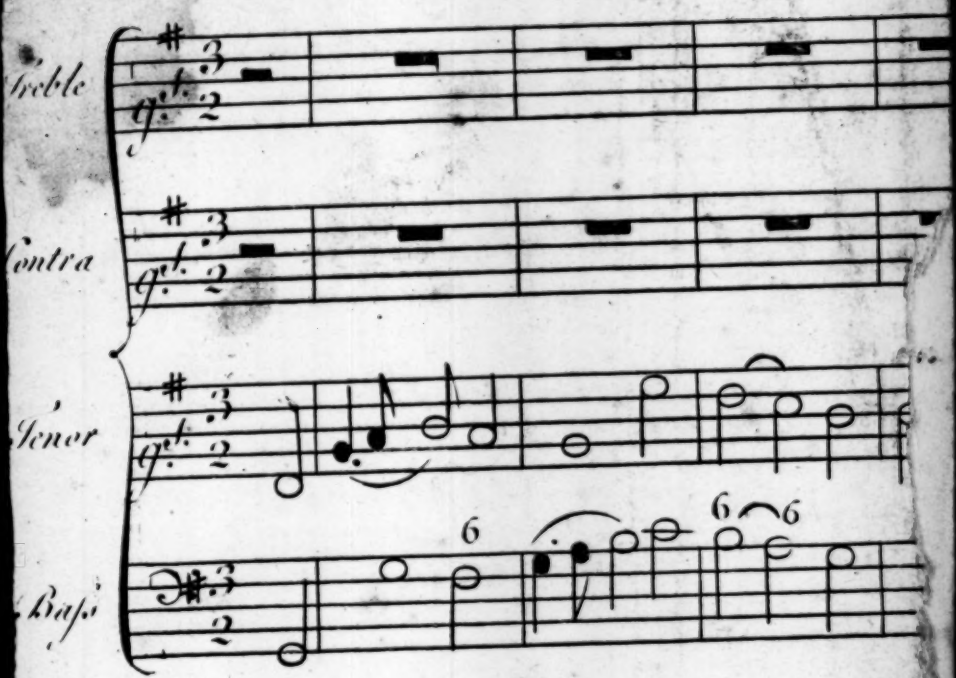
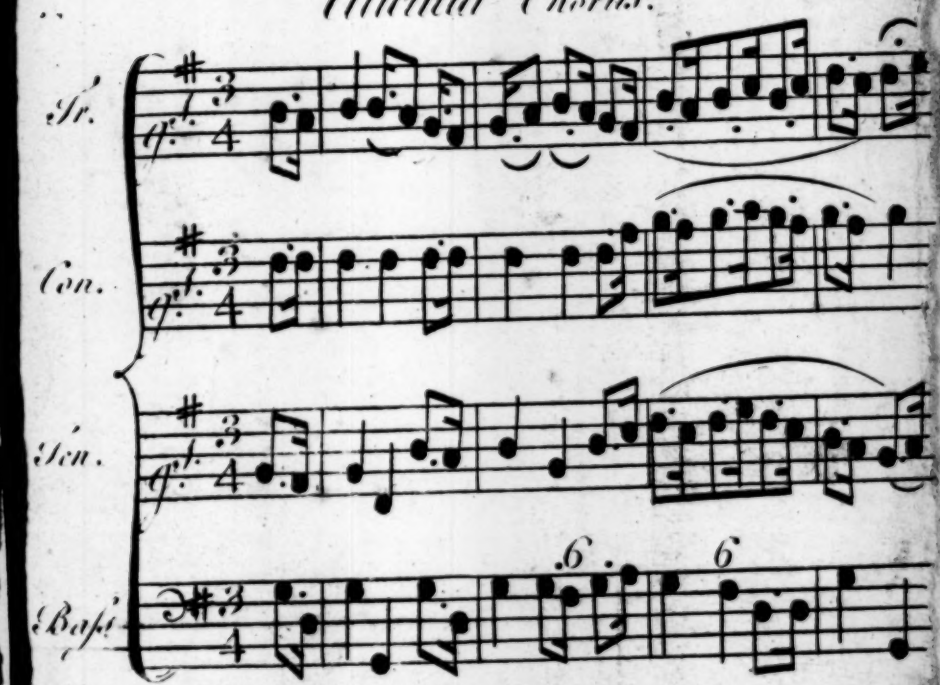


Fig. 4. Of Time





FREDERICK's Tune.



Alleluia Chorus.